Free. Eng.

SYSTRON DONNER
A THORN EMI company

6020/6030

SYSTRON DONNER
Member THORN EMI Group

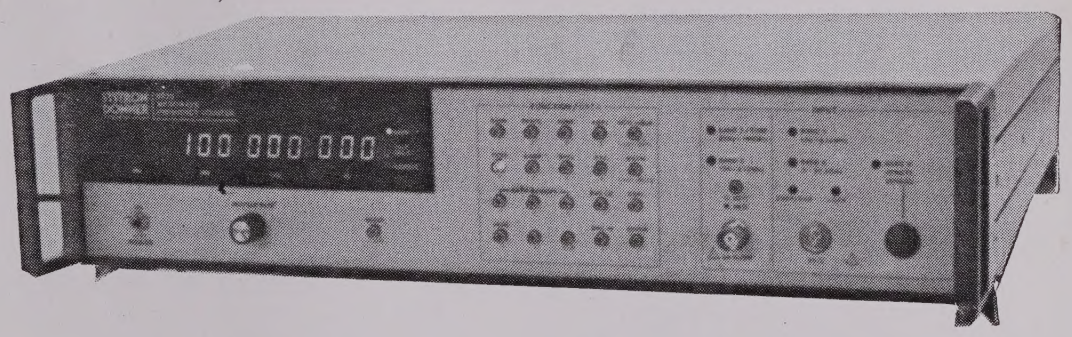
6020/6030

INSTRUMENT DIVISION

MICROWAVE FREQUENCY COUNTER

DOCUMENT NO. 120075-01

OPERATING MANUAL



2727 Systron Drive • Concord, California 94518 • U.S.A.
Tel: (415) 676-5000 • TWX: 910-481-9479 • Cable: SYSTRON DONNER
FSCM No. 52542

Copyright © 1982 Systron Donner
Printed in U.S.A.

LIST OF EFFECTIVE PAGES

(Revision/Configuration Control Document)

The 6020/6030 Microwave Frequency Counter Operating Manual is a revision/configuration controlled document. Original pages are date coded 10-84; pages changed in the future will be indicated according to respective revision date(s):

Total Number Of Pages In This Publication Is 53, Consisting Of The Following:

Page No.	Issue Date	Page No.	Issue Date
Title	1982	Table of Contents i - ii	10-84
Warranty	1982	1-1 - 1-19/(1-20 blank)	10-84
Proprietary Rights Statement . .	1982	2-1 - 2-5/(2-6 blank)	10-84
List of Effective Pages - A . . .	10-84	3-1 - 3-27/(3-28 blank)	10-84

TABLE OF CONTENTS

CHAPTER		PAGE
1 - GENERAL INFORMATION		
1-1	Introduction	1-1
1-4	Manual Effectivity	1-1
1-6	General Description	1-1
1-10	Functional Block Description	1-1
1-12	Time Base	1-2
1-16	Input Signal Conditioning.	1-2
1-27	Counter and Control Logic.	1-3
1-34	A1, CPU/Interface	1-4
1-36	A3, Display	1-4
1-38	Specifications	1-4
1-40	Standard Options	1-7
1-42	Available Accessories	1-8
1-44	Safety Practices	1-9
2 - INSTALLATION		
2-1	Introduction	2-1
2-3	Receiving Inspection	2-1
2-6	Power Requirements	2-1
2-10	Installation	2-1
2-12	Bench Mounting	2-2
2-15	Rack Mounting	2-2
2-18	Mating Connectors	2-3
2-20	GPIB System Connection, Remote Programming	2-3
2-24	Preparation for Reshipment	2-4
3 - OPERATION		
3-1	Introduction	3-1
3-3	Front Panel Controls, Indi-Indicators Displays and Connectors	3-1
3-5	Power and Reset-Local Switches	3-1
3-9	Function/Data Seciton Controls	3-2
3-11	Math Key Operation	3-5
3-14	Display Section	3-5
3-16	Input Section	3-6
3-18	Rear Panel Features	3-8
3-20	Measurement Considerations	3-9
3-23	Measurement Errors	3-9
3-26	Gating Ambiguity Errors	3-9

CHAPTER		PAGE
3 - OPERATION (Cont'd)		
3-30	Time Base Error	3-10
3-34	Trigger Error	3-11
3-37	Operating Characteristics	3-11
3-44	Operating Procedures	3-12
3-46	Receiving Inspection Test	3-12
3-48	Band 1 10 Hz to 100 MHz Operation	3-14
3-49	Band 2 100 to 512 MHz Operation	3-15
3-50	Band 3 100 to 512 MHz Operation	3-15
3-51	Band 4 500 MHz to 18/26.5 GHz Operation	3-15
3-52	Tone 10 Hz to 100 MHz Operation	3-15
3-53	Amplitude Measurement	3-15
3-54	Offset (+-) Scaling (X) and Normalization ( ) Operation	3-15
3-56	Remote Operating Procedures (IEEE Std 488 GPIB)	3-16
3-58	IEEE Std 488 Implemented Interface Function Subsets.	3-17
3-60	Address Assignment Procedures	3-17
3-64	Programming Procedure	3-18
3-67	6020/6030 Device Commands	3-18
3-69	Polling and Status Byte Generation	3-18
3-72	output Data Format	3-22
3-78	Output Modes	3-23
3-85	Error Messages	3-23
3-87	DAC Operation	3-24
3-89	DAC Interpolate Mode	3-24
3-92	DAC 3-Digit Mode	3-24
3-95	Frequency Lock Mode	3-25
3-99	Special Functions	3-25

LIST OF FIGURES

FIGURE		PAGE
1-1	Functional Block Diagram	1-17
1-2	Interconnect Block Diagram.	1-19
2-1	Operating Voltage Selection	2-2

TABLE OF CONTENTS

CHAPTER		PAGE

LIST OF FIGURES (Cont'd)

FIGURE		PAGE
2-2	Outline and Dimension/Rack Mounting Diagram	2-5
3-1	6030 Frequency Counter . .	3-1
3-2	Front Panel Function/Data Controls	3-2
3-3	Front Panel Display Section	3-5
3-4	Model 6030 Front Panel Input Section	3-6
3-5	6020/6030 Rear Panel . . .	3-8
3-6	Gating Ambiguity Error, Reciprocal Counting vs. Frequency Counting	3-10
3-7	Trigger Error	3-11
3-8	FM Characteristics	3-12
3-9	Dynamic Operating Range	3-12

LIST OF TABLES

TABLE		PAGE
1-1	Specifications	1-4
1-2	Standard Options	1-7
1-3	Available Accessories . .	1-9
1-4	Signal Names/Mnemonics . .	1-9
2-1	GPIB Interface Connector .	2-3
3-1	Function/Data Controls . .	3-2
3-2	Display Section	3-6
3-3	Input Section	3-7
3-4	Rear Panel Operational Features	3-8
3-5	Implemented Interface Function Subsets	3-17
3-6	Talk/Listen Address . . .	3-17
3-7	Device Command Menu . . .	3-19
3-8	Status Byte Format	3-22
3-9	Error Messages	3-23
3-10	Special Functions	3-26

CHAPTER 1

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This instruction manual contains information relating to the installation and operation of the Systron Donner 6020/6030 Microwave Frequency Counter.

1-3. The information contained in this operating manual is divided into front matter and three descriptive chapters, cas indicated in the following format:

Front Matter: includes title page, warranty policy, proprietary rights statement, list of effective pages, table of contents and safety practices information.

Chapter 1 - General Information: contains a functional description of the 6020/6030 Frequency Counter including specifications, accessories supplied, standard options available and safety practices.

Chapter 2 - Installation: Provides the receiving inspection, installation criteria, initial turn-on and confidence checks, system interface via the IEEE Std 488 GPIB (General Purpose Interface Bus) and preparation for reshipment.

Chapter 3 - Operation: describes the front and rear panel functions. General instrument operating procedures of each mode and function, procedures for operation via the IEEE Std 488 GPIB and system applications are also provided.

1-4. MANUAL EFFECTIVITY

1-5. Information contained in this Operating Manual is date-coded at the bottom of each page. A summary of these date codes is given in the List of Effective Pages (A page) located within the front matter of this manual. Any future changes will be reflected in the List of Effective Pages.

1-6. GENERAL DESCRIPTION

1-7. The 6020/6030 Microwave Frequency Counter is a high performance system oriented microprocessor base microwave counter. Frequency measurements to 18 GHz/26.5 GHz, input power measurements (amplitude), and a unique Function/Data Keyboard are operational at the front panel or from a remote controller devi- via the GPIB interface.

1-8. The microprocesor controlled keyboard allows unlimited offset functions as a standard feature, as well as providing numerous math and unique programming functions. It is also used to provide interactive diagnostics.

1-9. The 12 digit display is sectionalized for easy readout to 1 Hz resolution. The frequency range 10 Hz to 26.5 GHz is covered in four bands. Band 1, is selectable with either a 50 ohm input or a high impedance 1 megohm/50 pF input and covers a 10 Hz to 100 MHz range with sensitivity of 25 mV rms for 50 ohm or 1 meg. Band 2 covers 100 MHz to 512 MHz with -25 dBm sensitivity using the same BNC input connector as Band 1. Band 3 duplicates Band 2 frequency range however is applied to the Band 4 type N/sma input connector. Band 4 has an input impedance of 50 ohms nominal over the microwave range 500 MHz to 18/26.5 GHz and a sensitivity of -30/-20 dBm. For frequencies above 26.5 GHz, a Remote Sensor with appropriate waveguide input is optionally available and has been designated Band 5.

1-10. FUNCTIONAL BLOCK DESCRIPTION

1-11. Refer to Figure 1-1 6020/6030 Functional Block Diagram for the following discussion. The block level description is divided into functional areas with each function described in terms of

input, output and signal conversion. A function may contain more than one hardware assembly. Figure 1-1 presents this functional view and considerable hardware detail is omitted. Figure 1-2 is an interconnect block diagram showing major signal and control lines interface. Table 1-4 is a listing of the mnemonics and signal names assigned to all the signal interconnections between the different assemblies. For complete hardware interconnect data refer to the service manual.

1-12. Time Base

1-13. The measurement accuracy of a frequency counter is a function of its time base accuracy. The 6010/6030 time base is derived from either an internal (10 MHz) or external (1 MHz or 10 MHz) frequency standard. The internal 10 MHz standard is generated by A8, Time Base Oscillator Assembly, a TCXO (Temperature Compensated Crystal Oscillator). External frequency standards of either 1 MHz or 10 MHz can be connected via the rear panel. The appropriate frequency standard is selected by rear panel switch S3 (INT/EXT).

1-14. A timer circuit in A1 and gate logic in A2 determines the counters measurement gate time from the selected frequency standard, based on front panel frequency (BAND) and resolution settings. Measurement gate times are extneded X4 for Band 2 and 3 input signals, compensating for the divide-by-4 frequency prescaling in A4.

1-15. A counter self test signal 100 MHz, is also generated by the time base logic in A2. When the TEST PBI is pressed the 100 MHz self test signal excercises the Counter Logic A2, Interface Logic A1 and Display A3.

1-16. Input Signal Conditioning

1-17. The 6020/6030 Frequency Counter measures frequencies from 10 Hz to 26.5 GHz (110 GHz if equipped with Band 5) in three modes. Three seperate input channels provide the necessary signal conditioning to cover this range. The low range mode provides reciprocal or normal gate mode frequency measurements to 100 MHz. A divide-by-four prescaler is added to provide frequency counting to 512 MHz, and FLACTO technique (Frequency Locked Automatic Computing Transfer Oscillator) for frequency measurements to 26.5 GHz. Additional circuitry provides interface capability for systems application and a microprocessor to provide new technology for signal handling and manipulation.

1-18. Band 1 input signals (10 Hz to 100 MHz) connected to J2 are amplified by A4 then sent to the band selector logic in A5 as the A AMP signal. The A AMP signal is processed by A5 and routed to the count chain as the B Input signal.

1-19. Band 2 input signals (100-512 MHz) connected to J2 are amplified and prescaled (divide-by-four) by A4 then sent to the A5 band selector as the PRESCALER signal. The PRESCALER signal is then routed to the count chain.

1-20. Band 3 input signals (also 100-512 MHz) connected to J3 are coupled through Down Converter Module U1 to A4 where it is amplified and prescaled (divide-by-four). The prescaled signal is then routed to the count chain.

1-21. Band 4 input signals (0.5-18/26.5 GHz) connected to J3 are processed by the FLACTO channel then sent to the count chain. The Band 4 input cannot be measured directly by the counter therefore the FLACTO technique is used to divide the Band 4 input by N. The appropriate subharmonic of the Band 4 input is then counted and displayed. N is the harmonic relationship between the local oscillator and Band 4 input, and will have a value >4 but <255. The FLACTO circuits consists of the Down Converter Module U1, LO and Logic Assembly A5 and the IF and PM Assembly A6.

1-22. The Down Converter Module contains a PIN Leveler, a power splitter, detector and two Samplers (mixer). The detector output (DET) of the splitter is fed back to the PIN Leveler as a level control (LEV) signal. An increase in the Band 4 Input signal level causes a corresponding increase in the attenuation of the PIN Leveler. The feedback, and therefore the signal level into the FLACTO, is adjustable from A6. A sample of the detector output level control is coupled to the overload circuits and blinks the overload LED if the input level exceeds approxiamtely +20 dBm.

1-23. The unknown Band 4 frequency is divided into two signal paths by the power splitter and sent to the A and B Samplers. Sampler A is in the frequency lock path and is driven by the lock local oscillator (LLO) output of A5. Sampler B is in the N computing path and is driven by the N Local Oscillator (NLO). The samplers generate a range of harmonics (>4 but <255) from their respective local oscillator inputs, which are then mixed with the Band 4 input. The difference frequency output from Sampler A is the lock path if (LIF). The difference frequency output from Sampler B is the N Computing path if (NIF).

1-24. The LLO output from A5 is typically <105 MHz but >85 MHz. The NLO output of A5 tracks 1 kHz higher than the LLO. Therefore NLO = LLO +1 kHz. The difference between LIF and NIF in kHz is the harmonic (N) being used, where NIF >LIF. That is; if NIF = 5.080 MHz and LIF = 5.000 MHz then the local oscillator harmonic (N) is 80.

1-25. Prior to a frequency lock, a ramp generator on A5 sweeps the LLO from 105 MHz to 85 MHz. The swept LLO generates a range of harmonics in Sampler A, which mix with the Band 4 Input. The LIF frequency is determined by a discriminator on A6. A lock will occur only if LIF is 1-13 MHz. As the optimum mixing frequency is approched, the discriminator (DISC) output of A6 overrides the sweep ramp on A5, driving the local oscillator towards a lock. The DISC output of A6 controls the local oscillator frequency of A5 as long as lock is maintained.

1-26. Once frequency lock is established, the squelch (SQ) output of A5 enables the FLACTO Logic Assembly on A5. FLACTO computes the harmonic (N) by counting the 1 kHz X N output. Assuming an 1 kHz X N output of 80 kHz, N = 80. Once N has been computed, A5 outputs a C Input signal that is the LLO and a B Input signal that is the LIF. The unknown Band 4 frequency = (LLO x N) - LIF.

1-27. Counter and Control Logic

1-28. A2 the Counter and Control Assembly performs 4 major processing functions: 1. Development of the necessary reference clocks; 2. Time base and frequency counting; 3. DAC (digital-to-analog conversion) and 4. Control Interface.

1-29. The frequency of an input signal is determined by counting the number of cycles of an unknown frequency and the 100 MHz time base that occur during a specific gate time. Three signal conditioning channels provide the time base and the unknown frequency, the A input 100 MHz clock, the B input and the C input.

1-30. The Time Base Oscillator A8 provides a 10 MHz reference which is coupled at J3 to the time base control circuits of A2. The control circuits provide selection of the internal 10 MHz reference or an external 1/10 MHz reference; a 100 MHz VCO; and associated circuitry to develope a 200 kHz reference, the TIME BASE OUT monitor on the rear panel, a 100 MHz not locked flag, a 100 MHz PLL reference and the 100 MHz A Input Clock.

1-31. The B and C input signals (derived from the unknown frequency input applied to the Counter) and the A input (100 MHz) are counted. The resultant data is coupled to A1 the CPU/Interface Assembly where it is processed and coupled to A3 the Display Assembly for digital display of the unknown frequency.

1-32. The DAC accepts data from the A1 CPU and Interface Assembly and the A2 Counter circuits to develope the DAC out signal.

1-33. Control data such as counter signal selection, Band 3 and 4 control, counter reset and various status flags are handled by PIA's on A2.

1-34. A1, CPU/Interface

1-35. Microprocesor control, GPIB interface and digital display data are processed on A1. The CPU as programmed by the operator stores the appropriate information for circuit operation. Measurement data, frequency/amplitude are processed and routed to A3 the display circuits. Remote GPIB operation of the counter is also handled by A1. Related frequency mode, resolution, time base gating and control signals are selected by the CPU and routed to A2 the counter and control circuits.

1-36. A3, Display

1-37. A sectionalized 12-digit display with leading zero suppression provides an unambiguous digital readout of the measured frequency. Each section of the display is indicative of its frequency and is direct reading. Thus the three LSD's depict hundreds, tens and units of Hz while the MSD's denote GHz. Frequency denoting annunciators are illuminated below the digital display. There are two rows of annunciators. The top row illuminates GHz - Hz and is displayed for frequency measurements. The bottom row MHz - Hz and dBm, is illuminated for tone and amplitude measurements. Resolution is affected by blanking of the LSD's in the display. i.e. for 1 kHz resolution the three LSD's are blanked; for 1 Hz resolution none are blanked.

1-38. SPECIFICATIONS

1-39. Table 1-1 lists the specifications applicable to the counter. Any acceptance test or calibration procedure will refer these specifications as a tolerance guide.

Table 1-1. Specifications

Frequency Range	
6020:	10 Hz to 18 GHz.
6030:	10 Hz to 26.5 GHz.
Band 1 Low Frequency 100 MHz	
Range:	10 Hz to 100 MHz, (Normal or Reciprocal).
Sensitivity:	25 mV rms at 50 Ω or 1 MΩ.
Impedance:	1 meg/<50 pF or 50 Ω nominal.
Coupling:	AC.
Maximum Input (without damage)	
50 Ω:	5 V p-p to 100 MHz.
1 MΩ:	125 V rms 20 Hz to 500 kHz. 50 V rms 500 kHz to 5 MHz. 10 V rms 5 MHz to 100 MHz.
Input Connector:	BNC.
Tone:	Resolution 8-digits/second, minimum.
Band 2 and 3 Prescaler 512 MHz	
Range:	100 MHz to 512 MHz.
Sensitivity:	-25 dBm.
Impedance: Band 2/3:	1 MΩ/<50ipF or 50 Ω selectable.
Maximum Input:	5 V rms.
VSWR:	2:1 below +20 dBm.
Scale:	Divide-by-Four.
Coupling:	AC.

Table 1-1. Specifications (Cont'd)

Input Connector:	
Band 2:	BNC.
Band 3:	N(6020)/SMA(6030)
Band 4 Microwave 18 GHz/26.5 GHz	
Range 6020:	500 MHz to 18 GHz.
6030:	500 MHz to 26.5 GHz.
Sensitivity:	-30 dBm to 12.4 GHz. -25 dBm to 18 GHz. -20 dBm to 26.5 GHz (6030 only).
Impedance:	50 Ω nominal.
Coupling:	AC.
Input Connector:	N female (6020) SMA-3 mm (6030)
Maximum Input:	+30 dBm, +20 dBm prior to acquisition.
Operative Dynamic Range:	60 dB to 12.4 GHz. 55 dB to 18 GHz. 50 dB to 26.5 GHz (6030 only).
Measurement Time = Acquisition Time and Gate Time and Recycle Time	
Resolution 1 kHz to 1 MHz.	
Acquisition Time:	<75 msec
Gate Time:	1/R* x N* = <255 msec.
Recycle Time:	Calculation + Display = <200 msec.
Resoltuion 1 Hz to 100 Hz.	
Acquisition Time	<150 msec.
*R = Resoltuion; N	RF/100 MHz

Table 1-1. Specifications (Cont'd)

Resolution 1 Hz to 100 Hz (Cont'd)	
Gate Time:	1 sec to 10 msec.
Recycle Time:	Calculation + Display = <200 msec.
Amplitude Discrimination of two Frequencies: 20 dB amplitude separation (10 dB typical)	
AM Tolerance:	Any modulation index providing the minimum voltage of the signal is not less than the specified sensitivity.
FM Tolerance:	10 MHz p-p regardless of rate, worse case >1 GHz at low rates.
VSWR: (below limiting, -20 dBm)	<2:1 to 10 GHz. <2.5:1 to 18 GHz. <3:1 to 26.5 (6030 only).
Kickback Noise:	-65 dBm typical.
Lock Indicator:	Front Panel LED.
Overload Indicator:	Front Panel LED, flashes at +20 dBm.
Damage Level:	+30 dBm.
Time Base Oscillator	
Frequency:	10 MHz TCXO
Aging Rate:	±1 part in 10^8/day. ±3 parts in 10^7/month. ±1 part in 10^6/year.
Short Term:	±5 parts in 10^{10}/second.

Table 1-1. Specifications (Cont'd)

Frequency Retrace for off periods to 24 hours.	±5 parts in 10^7 within 15 minutes.
Temperature Variation:	<±5 parts in 10^7 over 0°C to 50°C.
Line Voltage Variation:	<±5 parts in 10^8 for ±10% change from normal.
Output Frequency:	10 MHz squareware, 2 V into 50 Ω.
External Time Base:	Requires 1 MHz or 10 MHz, 500 mV minimum sine or square wave into 500 Ω via rear panel BNC. Switch selectable (INT/EXT) at rear panel.

General Characteristics

Measurement Display:	12 digits, 0.4" high, in-line, 7 segment LED readout. Leading zero suppression, sectionalized GHz, MHz, kHz and Hz readout with annunciation.
Amplitude Display:	Six left most digits indicate frequency display in MHz with 1 kHz resolution and three right most digits indicate amplitude display (xx.x dBm), will display -dBm when appropriate.
Display Storage/ Recycle Rate:	Controls time between measurements, continuously variable from 50 ms to 5 seconds. Switchable RCYL HOLD holds measurement display indefinitely.

Table 1-1. Specifications (Cont'd)

Automatic Self Test:	At power on automatically sequences memory locations, counters and keyboard controls to ensure proper operation.
Instrument Test:	Measures and displays internal 100 MHz Time Base.
Resolution:	1 Hz/sec minimum. 8-digits/sec minimum in TONE.
Math Capabilities:	Up to 3 levels of math operations. Each operation consists of a signed number (8 digit maximum) and a math operator of +, -, x or , in any order. Three separate math memories for each function. In addition, ΔF or ΔP measurements can be made via preprogrammed value, last measurement or last display.
Frequency Offsets:	Any offset frequency selectable through math package.
GPIB (IEEE 488):	Provides remote program control of all front panel functions except power. Output measurement data in 21 byte message format. Conforms to IEEE Standard Digital Interface for Programmable Instruments (IEEE Std 488-1978) and implements the following subsets.

Table 1-1. Specifications (Cont'd)

	SH1 Source Handshake, Full AH1 Acceptor Handshake, Full T5 Talk, Basic Talker, Unaddressed if MLA, Serial Poll, Talk Only Mode. TE0 Extended Talker, None L4 Listen, Basic Listener, Unaddressed if MTA. LE0 Extended Listener, None. SR1 Service Request, Full. RL1 Remote Local, Full PP0 Parallel Poll, None. DC1 Device Clear, Full. DT1 Device Trigger, Full. C0 Controller, None.
Operating Temperature:	0°C to 55°C.
Power Requirements:	100, 120, 220, 240, V ac +5%-10% 48 to 62 Hz. 100 watts maximum.
Environmental:	To MIL-T-2800, type III, Class 5, Style E.
Dimensions:	3.5" x 16.75" x 14" (H x W x D). 88.9 mm x 425.45 mm x 355.6 mm.
Weight:	Net 23 lbs (10.4 kg) Shipping 30 lbs (13.6 kg).

1-40. STANDARD OPTIONS

1-41. Table 1-2 lists the standard options available for the 6020/6030 Counters. Full descriptions and drawings, as appropriate, are included in respective chapters of this manual.

Table 1-2. Standard Options

Option	Description
01 DAC	Digital-To-Analog Converter. Converts any three consecutively displayed digits (frequency only) into an analog voltage output to the rear panel BNC, or interpolates between 2 selected frequencies or amplitude. Frequency stabilize mode will tune a frequency source to a desired frequency. 0 to 10 V or -10 V to +10 V output. 2.5 mV or 5 mV per step.
02 Power Measurement:	Measure input frequency amplitude to 0.1 dBm resolution and display it simultaneously with the frequency. Range: 0.1 GHz to 18 GHz/26.5 GHz only. Resolution: 0.1 dB. Dynamic Range and Accuracy: From counter sensitivity to +20 dBm ±1.5 dBm.
03 System Interface Language CIIL:	Allows system operation using Control Interface Intermediate Language, CIIL.
04 Rear Panel Input:	Provides rear panel inputs. Relocate input connectors from the front panel to the rear panel.

Table 1-2. Standard Options (Cont'd)

Option	Description
05 High Stability Oscillator:	High stability oscillator. Increased Timebase oscillator stability. Frequency: 10 MHz. Aging Rate: ±5 parts in 10^{10}/day after 72 hours warm up ±1.5 parts in 10^{8}/month. Short Term Stability: ±5 parts in 10^{11} rms/second. Line Voltage Variation: ±5 parts in 10^{10} for a 10% change from normal. <±2 parts in 10^{10}/°C typical, ±1 part in 10^{8}. Temperature Variation: Over 0°C to +60°C.
06 Rack Mount:	Provides for equipment rack mounting, without slides.
07 Rack Mount W/Slides:	Provides for equipment rack mounting, with slides.
20 Frequency Extension:	Internal option to allow frequency measurement beyond 26.5 GHz. Includes all required interface between counter and selected optional external mixer.
21 26.5-40 GHz External Mixer: (Optional Accessory)	Freq. Range: 26.5-40 GHz Sens. (Typ): -30 dBm Max Input (Typ): +5 dBm Damage Level: +10 dBm Waveguide: WR-28 Flange: UG-599/U Acq. Time: 150 ms

Table 1-2. Standard Options (Cont'd)

Option	Description
22 40-60 GHz External Mixer: (Optional Accessory)	Freq. Range: 40-60 GHz Sens. (Typ): -25 dBm Max Input (Typ): +5 dBm Damage Level: +10 dBm Waveguide: WR-19 Flange: UG-383/U Acq. Time: 150 ms
23 60-90 GHz External Mixer: (Optional Accessory)	Freq. Range: 60-90 GHz Sens. (Typ): -25 dBm Max. Input (Typ): +5 dBm Damage Level: +10 dBm Waveguide: WR-12 Flange: UG-387/U Acq. Time: 150 ms
24 90-110 GHz External Mixer (Optional Accessory)	Freq. Range: 90-110 GHz Sens. (Typ): -25 dBm Max. Input (Typ): +5 dBm Damage Level: +10 dBm Waveguide: WR-10 Flange: UG-387/U-M Acq. Time: 150 ms

1-42. AVAILABLE ACCESSORIES

1-43. The available accessories that may be ordered with the 6020/6030 instruments are listed in table 1-3.

Table 1-3. Available Accessories

Description	Part Number
Manual, Service	120075-02
IEEE-488 Cables	
1 meter	11707601
2 meter	11707602
3 meter	11707603

1-44. SAFETY PRACTICES

1-45. Prior to operation or maintenance of the 6020/6030, technical personnel are encouraged to review the safety practices section located in the front matter of this manual. Removal of the top or bottom cover while the instrument is operating, exposes personnel to possible contact with dangerous potentials. Only allow qualified personnel to maintain this instrument.

Table 1-4. Signal Names/Mnemonics

Mnemonic or Name	From	To	Function
A AMP + A AMP -	A4J1-12 A4J1-10	A5J3-12 A5J3-10	Band 1 and 2 Input Frequency
ATN	J8-11 A1J5-11		GPIB Attention Line
BAND SW	A2J2-28 A5J2-28	A5J2-28 A4-6	Band 2 Select
BA0	A1J4-21 A2J4-21		Address Bit 0
BA1	A1J4-20 A2J4-20		Address Bit 1
BA2	A1J4-19 A2J4-19		Address Bit 2
BD0 (W4)	A1J4-3 A2J4-3		Counter Bidirectional Data Bit 0
BD1 (W4)	A1J4-2 A2J4-2		Counter Bidirectional Data Bit 1
BD2 (W4)	A1J4-4 A2J4-4		Counter Bidirectional Data Bit 2
BD3 (W4)	A1J4-3 A2J4-3		Counter Bidirectional Data Bit 3
BD4 (W4)	A1J4-33 A2J4-33		Counter Bidirectional Data Bit 4
BD5 (W4)	A1J4-32 A2J4-32		Counter Bidirectional Data Bit 5

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
BD6 (W4)	A1J4-31 A2J4-31		Counter Bidirectional Data Bit 6
BD7 (W4)	A1J4-30 A2J4-30		Counter Bidirectional Data Bit 7
COL 1	A1J2-17	A3J2-17	Key Pad Matrix Column Address 1 Bit
COL 2	A1J2-18	A3J2-18	Key Pad Matrix Column Address 2 Bit
COL 3	A1J2-19	A3J2-19	Key Pad Matrix Column Address 3 Bit
COL 4	A1J2-20	A3J2-20	Key Pad Matrix Column Address 4 Bit
CPU RESET	A2J4-11	A1J4-11	CPU Power Up Reset
DAC OUT (W20)	A2 DAC OUT Pad	Rear Panel J10	DAC Output Signal
DAV	A1J6-6 Rear Panel J8-6		GPIB Data Valid
dB	A1J2-4	A3J2-4	dBm Annunciator Signal
DELAY STOP	A1J4-17	A2J4-17	Time Base Gate Delay Stop
DET (W15)	U1J5	A6-RF DET	Detector Input Power Level
DISC	A6J1-9	A5J1-9	LIF Discriminator Signal
DIO 1	A1J5-1 Rear Panel J8-1		GPIB Data Bit 1
DIO 2	A1J5-2 Rear Panel J8-2		GPIB Data Bit 2
DIO 3	A1J5-3 Rear Panel J8-3		GPIB Data Bit 3
DIO 4	A1J5-4 Rear Panel J8-4		GPIB Data Bit 4
DIO 5	A1J5-26 Rear Panel J8-26		GPIB Data Bit 5

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
DIO 6	A1J5-25 Rear Panel J8-25		GPIB Data Bit 6
DIO 7	A1J5-24 Rear Panel J8-24		GPIB Data Bit 7
DIO 8	A1J5-23 Rear Panel J8-23		GPIB Data Bit 8
DSPL GND	A1J3-15	A3J3-15	Display Gnd
DSPL GND	A1J3-16	A3J3-16	Display Gnd
DSPL +5 V	A1J2-15	A3J2-15	+5 V
DSPL +5 V	A1J2-16	A3J2-16	+5 V
E	A1J4-4	A2J4-4	CPU Enable (2 MHz Clock Pulse)
EOI	A1J5-5 Rear Panel J8-5		GPIB End Or Identify
EXT IF (W27)	A9	A5J6	Extender IF Signal
EXT LO (W26)	A9	A5J7	Extender LO Signal
EXT 1/10 MHz	Rear Panel J12	A2 EXT 1/10 MHz Pad	External Time Base Oscillator Input
FAULT 1	A2J1-9	Rear Panel J11	DFI Flag
FAULT 2	A2J1-10	Rear Panel J11	DFI Flag
FREQ A	A1J2-1	A3J2-1	GHz, MHz Annunciator LED's Address
FREQ B	A1J2-2	A3J2-2	kHz, Hz Annunciator LED's Address
GATE	A2J4-18	A1J4-18	Count Gate
HI RANGE	A2J2-23	A5J1-11	
IF	A6J1-2	A5J1-2	ACTO IF Signal
IFC	A1J4-23	A2J4-23	Internal Interface Clear
IFC	A1J5-9 Rear Panel J8-9		GPIB Interface Clear

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
IF GND	A6J1-1	A5J1-1	ACTO if Signal Ground
INPUT BAND 1,2	Front Panel J2	A4 A Pad	Input Frequency Band 1 and 2
INPUT BAND 3,4	Front Panel J3	U1J1 (RF IN)	Input Frequency Band 3 and 4
INPUT BAND 5	Front Panel J9	A9J2	Input Frequency Band 5
INPUT B + INPUT B -	A5J2-5 A5J2-36	A2J2-5 A2J2-36	Frequency Count To B Counter and Count Gate
INPUT C + INPUT C -	A5J2-8 A5J2-33	A2J2-8 A2J2-33	Frequency Count to C Counter
INT/$\overline{\text{EXT}}$ SW	Rear Panel S3	A2J1-11	INT/$\overline{\text{EXT}}$ Oscillator Selection
INT 10 MHz (W17)	A8	A2J3	Internal 10 MHz TB Reference
IRQ	A2J4-10	A1J4-10	CPU Interrupt Request
LEV (W14)	A6 LEV Pad	U1J7 (LEV)	Level Signal
LEV VOLTS	A6J1-10	A5J1-10	Input Level for Overload Detection
LIF (W12)	U1J4 (IF A)	A6 LIF Pad	LIF Signal
LLO (W11)	A5 LLO Pad	U1J3 (LO A)	LLO Signal
$\overline{\text{LLO}}$ ENABLE	A2J2-24	A5J2-24	LLO Enable Signal
LSB1	A1J3-8	A3J3-8	Key Pad Matrix LSB1
LSB2	A1J3-12	A3J3-12	Key Pad Matrix LSB2
LSB3	A1J3-11	A3J3-11	Key Pad Matrix LSB3
LSB4	A1J3-7	A3J3-7	Key Pad Matrix LSB4
La	A1J3-3	A3J3-3	LSD-LSD3 Display Segment Address
Lb	A1J3-20	A3J3-20	LSD-LSD3 Display Segment Address
Lc	A1J3-18	A3J3-18	LSD-LSD3 Display Segment Address

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
Ld	A1J3-5	A3J3-5	LSD-LSD3 Display Segment Address
Le	A1J3-19	A3J3-19	LSD-LSD3 Display Segment Address
Lf	A1J3-6	A3J3-6	LSD-LSD3 Display Segment Address
Lg	A1J3-4	A3J3-4	LSD-LSD3 Display Segment Address
Ldp	A1J2-1	A3J3-1	LSD-LSD3 Display Decimal Address
LSD	A1J3-10	A3J3-10	LSD Display Address
LSD1	A1J3-13	A3J3-13	LSD1 Display Address
LSD2	A1J3-9	A3J3-9	LSD2 Display Address
LSD3	A1J3-2	A3J3-2	LSD3 Display Address
LSD4	A1J1-13	A3J1-13	LSD4 Display Address
LSD5	A1J1-12	A3J1-12	LSD5 Display Address
LSD6	A1J1-11	A3J1-11	LSD6 Display Address
LSD7	A1J1-10	A3J1-10	LSD7 Display Address
LSD8	A1J1-9	A3J1-9	LSD8 Display Address
LSD9	A1J1-8	A3J1-8	LSD9 Display Address
LSD10	A1J1-7	A3J1-7	LSD10 Display Address
Ma	A1J1-4	A3J1-4	LSD4-MSD Display Segment Address
Mb	A1J1-1	A3J1-1	LSD4-MSD Display Segment Address
Mc	A1J1-19	A3J1-19	LSD4-MSD Display Segment Address
Md	A1J1-6	A3J1-6	LSD4-MSD Display Segment Address
Me	A1J1-20	A3J1-20	LSD4-MSD Display Segment Address
Mf	A1J1-18	A3J1-18	LSD4-MSD Display Segment Address
Mg	A1J1-5	A3J1-5	LSD4-MSD Display Segment Address
Mdp	A1J1-2	A3J1-2	LSD4-MSD Display Segment Address
MSD	A1J1-3	A3J1-3	MSD Display Address

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
MSQ	A5J2-19	A2J2-19	
NDAC	A1J5-8 Rear Panel J8-8		GPIB Not Data Accepted
NIF (W13)	U1J9 (IF B)	A6 NIF Pad	NIF Signal
NLO ENABLE	A5J2-15	A2J2-15	NLO Enable Signal
NLO (W10)	A5 N LO Pad	U1J8 (LO B)	NLO Signal to Sampler
NRFD	A1J5-7 Rear Panel J8-7		GPIB Not Ready For Data
OVERLOAD	A5J2-25	A2J2-25	Overload Signal
POWER MODE	A2J2-21	A5J1-13, A5J2-21, A6J1-13	Power Mode Address
POWER V/F	A6J1-3	A5J1-4	Power Frequency (V/F)
$\overline{\text{Ø LOCK ENABLE}}$	A2J2-20	A5J2-20	Phase Lock Enable Gate Signal
Ø LOCK REF	A2J2-17	A5J2-17	Phase Lock Reference Clock Signal
PRESCALER +	A4J1-14	A5J3-14	Prescaler Output Frequency
PRESCALER -	A4J1-8	A5J3-8	Prescaler Output Frequency
PRESCALER LEV	A4J1-4	A5J3-4, A5J2-27 A2J2-27	Prescaler Level Signal
RAMP LO	A5J2-18	A2J2-18	Ramp Signal
REN	A1J5-22 Rear Panel J8-22		GPIB Remote Enable
REF (W24)	A6 REF Pad	U1J6 (REF)	ACTO Reference Signal
RESET SQ	A2J2-16	A5J2-16	Squelch Reset
ROW A	A3J2-5	A1J2-5	Key Pad Row Address
ROW B	A3J2-6	A1J2-6	Key Pad Row Address
ROW C	A3J2-7	A1J2-7	Key Pad Row Address

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
ROW D	A3J2-8	A1J2-8	Key Pad Row Address
ROW E	A3J2-9	A1J2-9	Key Pad Row Address
ROW F	A3J2-10	A1J2-10	Key Pad Row Address
ROW H	A3J2-12	A1J2-12	Key Pad Row Address
ROW J	A3J2-11	A1J2-11	Key Pad Row Address
$\overline{\text{RS2400}}$	A1J4-15	A2J4-15	Read Selects Address
$\overline{\text{RS2480}}$	A1J4-14	A2J4-14	Read Selects Address
$\overline{\text{RS2500}}$	A1J4-13	A2J4-13	Read Selects Address
$\overline{\text{RS2580}}$	A1J4-12	A2J4-12	Read Selects Address
RECYCLE RATE	A3J2-13	A1J2-13	Recycle Rate Time
R/$\overline{\text{W}}$	A1J4-5	A2J4-5	Read Not Write Signal
$\overline{\text{SEL 36}}$	A1J4-8	A2J4-8	Read Not Write Selects Address
$\overline{\text{SEL 38}}$	A1J4-7	A2J4-7	Read Not Write Selects Address
SGNL A0	A2J2-12	A5J2-12	Address Bit
SGNL A1	A2J2-30	A5J2-30	Address Bit
SGNL A2	A2J2-31	A5J2-31	Address Bit
SGNL B0	A2J2-14	A5J2-14	Address Bit
SGNL B1	A2J2-26	A5J2-26	Address Bit
SGNL B2	A2J2-13	A5J2-13	Address Bit
SQ	A6J1-8	A5J1-8	Squelch
SRQ	A1J5-10 Rear Panel J8-5		GPIB Service Request
TONE	A1J2-3	A3J2-3	MHz, kHz, Hz Tone Annunciator LED's Address
TIME BASE OUT (W19)	A2 TB Out Pad	Rear Panel J13	10 MHz/1 MHz Time Base Out Signal

Table 1-4. Signal Names/Mnemonics (Cont'd)

Mnemonic or Name	From	To	Function
SCANRST	A1J4-16	A2J4-16	
TO	Rear Panel A10/S4-10	A1J6-10	Talk Only Address
$\overline{\text{WS2100}}$	A1J4-9	A2J4-9	Write Select Address
$\overline{\text{WS2200}}$	A1J4-8	A2J5-9	Write Select Address
50 Ω/1 M RELAY	A2J2-29/ A5J2-29,J3-17	A4J1-17	Band 1 Input Impedance Select
200 kHz TIMER	A2J4-22	A1J4-22	200 kHz Clock to CPU Timer
100 MHz +	A2J2-2	A5J2-2	Phase Lock Loop
100 MHz -	A2J2-40	A5J2-40	100 MHz Reference

CHAPTER 2

INSTALLATION

2-1. INTRODUCTION

2-2. This chapter outlines the procedures for initial inspection and installation of the 6020/6030. The subject matter includes receiving inspection and installation criteria. Also provided is information on the IEEE Std-488 GPIB system interface. Instructions concerning preparation for reshipment are included at the end of this chapter.

2-3. RECEIVING INSPECTION

2-4. As soon as the instrument is received, check the shipping container for evidence of damage or rough handling. Any sign of such damage must be noted by both the shipper and the receiver and should be reported to the insurance investigator.

2-5. Immediately after removal from the shipping container, inspect the instrument for any possible physical damage that may have been incurred in shipment. Check surfaces for scratches and dents and note the condition of control knobs and connectors. Should any damage be detected, notify your Systron Donner representative - DO NOT USE THE INSTRUMENT UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2-6. POWER REQUIREMENTS

2-7. The 6020/6030 is provided with a detachable three-conductor power cord, which grounds the instrument chassis when connected through a compatible power receptacle.

WARNING

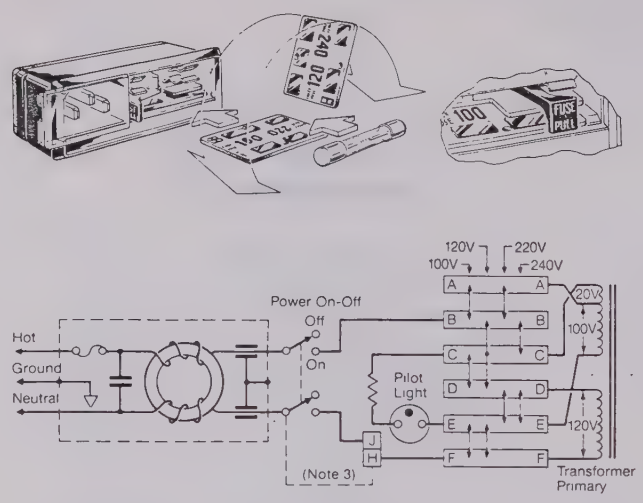
Before applying power to this instrument, ensure that the protective earth terminals of the instrument are connected to the protective conductor of the (mains) power cord. The power cord plug shall only be inserted in an outlet provided with protective earth contact. The protective conductor must not be negated by use of an extension cord without a protective grounding conductor.

2-8. The 6020/6030 operate over the line voltage range of 100-120/220-240 V ac, 48 to 66 Hz and require <100 W maximum power. The instrument is shipped from the factory configured for 120 V ac operation. If other than 120 V ac is required, the voltage select PCB must be oriented appropriately. Refer to figure 2-1 for voltage selection instructions.

2-9. Ensure that the 120 to 240 V line voltage selector is in the correct position and that the main power fuse is of the proper rating before connecting the instrument to a power source.

2-10. INSTALLATION

2-11. An outline and dimension/rack-mounting diagram is provided in figure 2-2 to assist in the installation of the instrument.



1. Remove power cord and slide window cover up.
2. Draw fuse extractor up and remove fuse.
3. Remove PC selector board and rotate until desired voltage is shown on top left side.
4. Reinsert PCB firmly into module slot.
5. Return fuse extractor to normal position, and insert appropriate fuse.
6. Slide window down and insert power cord.

Figure 2-1. Operating Voltage Selection

NOTE

The rear panel must remain unobstructed (4" to 6" clearance) while the instrument is operating to provide air flow to the blower; also access to rear panel switches and connectors is required. Periodic air filter servicing also requires access to the rear panel.

2-12. Bench Mounting

2-13. The 6020/6030 instruments may be installed on a bench with clearance provided for rear panel connectors and switch access. The air intake and exhaust ports, located on the rear panel, must remain unobstructed to allow adequate cooling of the instrument.

2-14. The instrument is supplied with a swing-down bail mounted on the front of the bottom cover. When extended, this bail will tilt-up the instrument allowing a comfortable viewing angle.

2-15. Rack Mounting

2-16. The rack mount accessory kit (SD P/N 07715401) contains two rack mounting brackets, and four 10-32 x 5/8 screws. To assemble, remove the two forward bottom-row cover screws on the right and left hand sides of the unit. Attach the right and left hand rack-mounting bracket to each side of the unit with the supplied hardware as shown.

NOTE

When rack or console mounting the instrument, determine if the bail/bumper feet will interfer; then remove these items as required.

CAUTION

The 6020/6030 instruments weigh 10.4 kg (23 lbs). Be sure to provide adequate support within the rack by a cross brace or a strain bracket. Exercise care when installing or removing the unit to avoid personal injury.

2-17. Equipment rack slides are recommended when rack or console mounting the unit. The slides are available from the factory as a standard accessory (SD P/N 07715501). Follow the mounting procedure outlined in paragraph 2-15. When completed, check the installation to be certain the unit's cover retaining screws are accessible to allow cover removal should servicing be required.

2-18. MATING CONNECTORS

2-19. The low frequency input is a coaxial type bnc female connector, input impedance is front panel switch selectable at 50 Ω or 1 MΩ, shunted by <50 pF. The 6020 Band 3 and 4 (100 MHz to 18 GHz) is a coaxial type N female connector having an input impedance of 50 Ω nominal. The 6030 Band 3 and 4 (100 MHz to 26.5 GHz) is a coaxial sma-3 mm female connector having an input impedance of 50 Ω nominal. The rear panel TIME-BASE DAC and DFI connectors are coaxial type bnc female connectors. The IEEE 488 Interface connector is a 24-pin metric-dimensioned connector per IEEE Std 488-1978 and is compatible to an Amphenol 57-30204 mating connector.

2-20. GPIB SYSTEM CONNECTION, REMOTE PROGRAMMING

2-21. The GPIB permits data bus control of the 6020/6030 according to IEEE Standard Digital Interface for Programmable instruments (IEEE Std 488-1978).

2-22. To implement the GPIB, a 24-pin metric-dimensioned connector and a 5-digit Address/PROG-TALK ONLY switch is provided on the rear panel of the instrument.

2-23. A detailed description of the GPIB interface operation is given in chapter 3. Table 2-1 provides the pin assignments for the rear panel GPIB 24-pin connector.

Table 2-1. GPIB Interface Connector

Pin Number	IEEE STD 488 Mnemonic
1	DIO1
2	DIO2
3	DIO3
4	DIO4
5	EOI
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	GND (Shield)
13	DIO5
14	DIO6
15	DIO7
16	DIO8
17	REN
18	GND (Return for DAV)
19	GND (Return for NRFD)
20	GND (Return for NDAC)
21	GND (Return for IFC)
22	GND (Return for SRQ)
23	GND (Return for ATN)
24	GND (Logic Return)

LEVELS:
True (1) state is 0.0 to +0.8 V dc false (0) state is +2.5 to +5.0 V dc.
MATING CONNECTOR:
Amphenol 57-30240
MATING CABLES:
IEEE Std 488 Cable - 1 meter length SD No. 11707601
IEEE Std 488 Cable - 2 meters length SD No. 11707602
IEEE Std 488 Cable - 3 meters length SD No. 11707603

2-24. PREPARATION FOR RESHIPMENT

2-25. When the instrument is to be repackaged for shipment, use the original packing materials or package in accordance with MIL-P-116 and MIL-E-17555E specifications.

2-26. Repackage the instrument using the following step procedures:

1. Attach an identification tag to the unit indicating model number, serial number, name and address of instrument owner, and a summary of the service or repairs required.

2. Wrap the instrument in heavy paper or plastic prior to placing it in the shipping container.

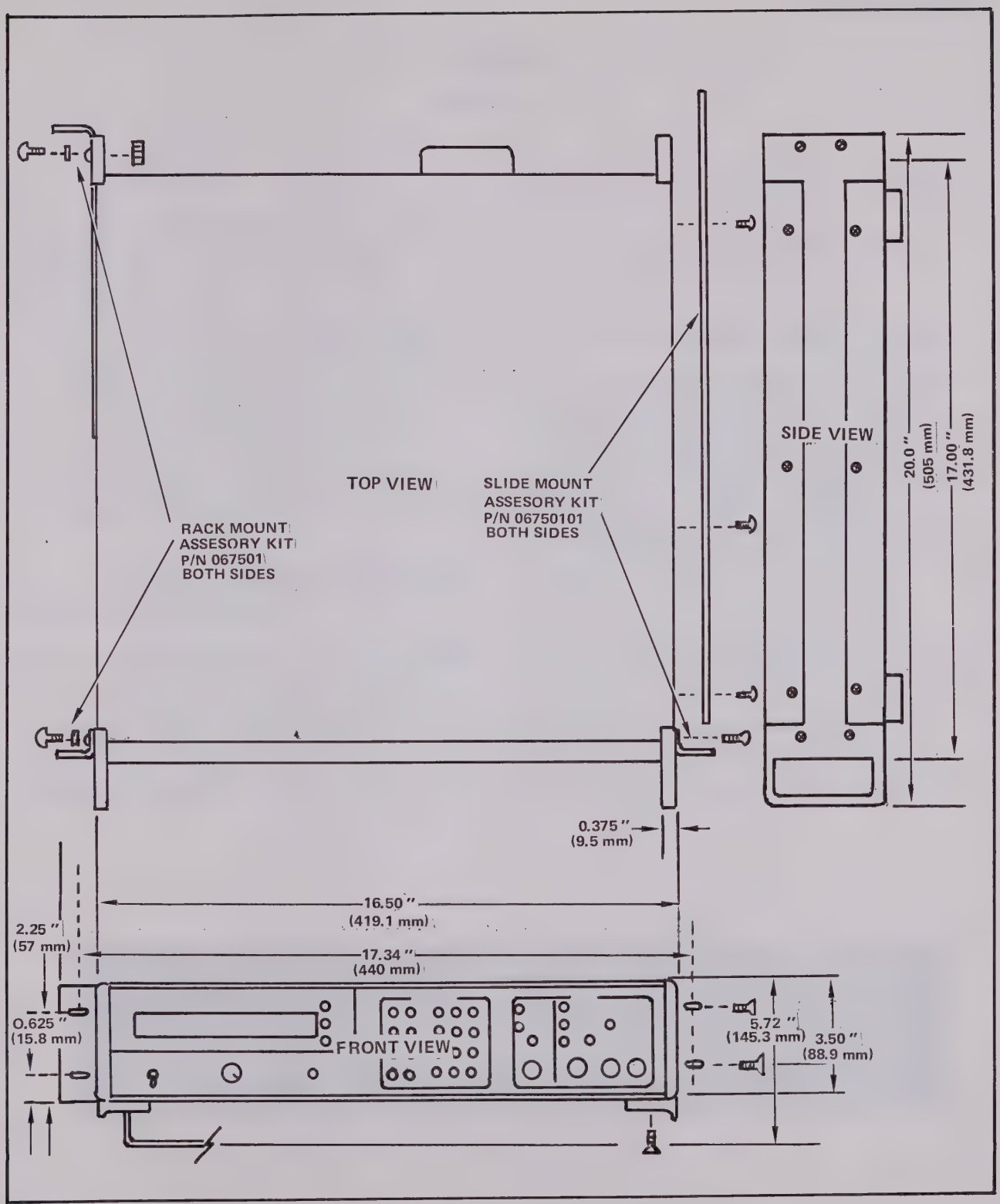
3. Select a strong carton or wooden box as a shipping container.

4. Use an adequate layer of shock-absorbing material on all six sides of the unit. Protect the instrument front panel with additional layers of cardboard. Ensure that no movement of the assembly is evident within the container.

5. Seal the shipping container with strong tape or metal bands and attach a packing list to the outside surface.

6. Mark the shipping container "FRAGILE-DELICATE INSTRUMENT" and attach the appropriate handling symbols to ensure reasonable care in transit.

7. Be certain that all correspondence relating to the service or repair of this instrument includes the information contained on the instrument identification tag.


TOP VIEW
SIDE VIEW
RACK MOUNT
ASSESORY KIT
P/N 067501
BOTH SIDES
SLIDE MOUNT
ASSESORY KIT
P/N 06750101
BOTH SIDES
20.0 "
(505 mm)
17.00 "
(431.8 mm)
0.375 "
(9.5 mm)
16.50 "
(419.1 mm)
17.34 "
(440 mm)
2.25 "
(57 mm)
0.625 "
(15.8 mm)
FRONT VIEW
5.72 "
(145.3 mm)
3.50 "
(88.9 mm)

CHAPTER 3

OPERATION

3-1. INTRODUCTION

3-2. This chapter describes the operation of the 6020/6030. First, the front and rear panel controls, indicators, displays and connectors are depicted and described as to their function and operational use. Next, basic measurement considerations are presented followed by basic measurement operational procedures. Next, remote procedures are presented for IEEE 488 GPIB operation to allow system application of the counter, and last, the failure messages, DAC operation and special functions are presented.

3-3. FRONT PANEL CONTROLS, INDICATORS, DISPLAYS AND CONNECTORS

3-4. Figure 3-1 depicts the front panel of the Model 6030 Frequency Counter. The Model 6020 is identical, except for the Band 3 and 4 input connector. Except for the POWER toggle switch, the RECYCLE RATE control and the RESET LOCAL pushbutton indicator (PBI), all controls and displays are grouped into three sections. These sections are as follows:

1. FUNCTION DATA Keyboard
2. Display section
3. The INPUT section

3-5. Power and Reset-Local Switches

3-6. The POWER toggle switch, when placed into its ON (up) position, applies power to energize the instrument. When placed in the STBY (down) position, the instrument is deenergized, but maintains power to the optional high stability oscillator (option 05) if installed. In instruments without option 05 installed, the STBY position of the POWER switch is analogous to off.

3-7. The RESET LOCAL pushbutton switch will reset the instrument and initiate a new measurement cycle when pressed while operating in the local mode. When operating in the remote mode (REMOTE LED illuminated on the display section and the counter under GPIB control), pressing the RESET LOCAL pushbutton switch

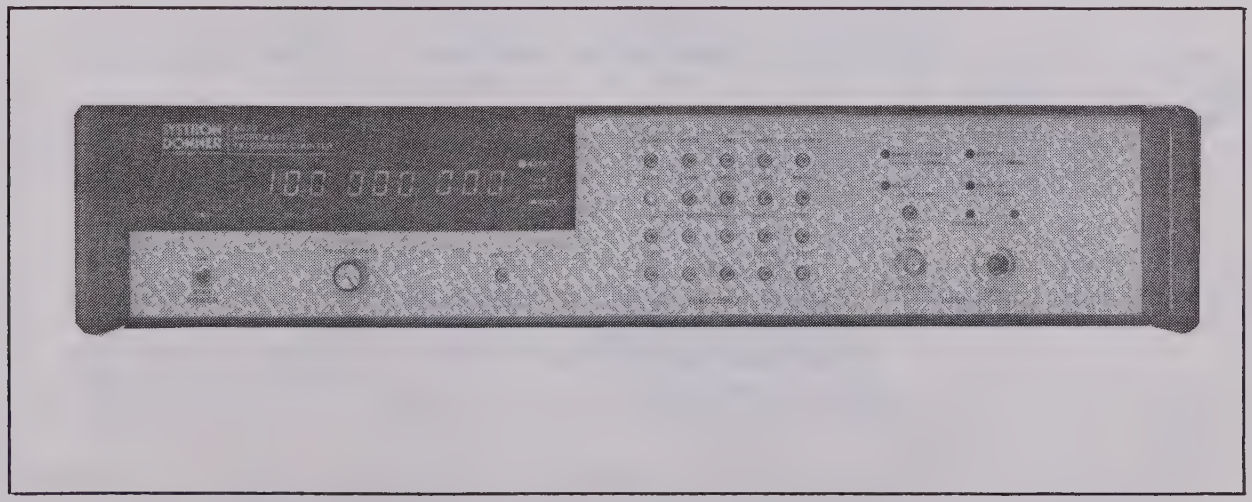


Figure 3-1. 6020 Frequency Counter

will place the counter in the local mode. This go-to-local function can be denied by a GPIB local lock-out command.

3-8. The RECYCLE RATE control varies the time between measurements from 50 ms to 5 seconds (recycle time begins at the start of the gate) and works in conjunction with the RCYL HOLD function. When the HOLD function is activated the recycle rate is locked out.

3-9. Function/Data Section Controls

3-10. Figure 3-2 depicts the function/data section of the front panel, and table 3-1 describes the controls. The function/data keyboard consist of 20 pushbuttons that control major functions and program data input of the counter. the PBI's (pushbutton indicators) are interactive and will flash indicating a function/data entry state.

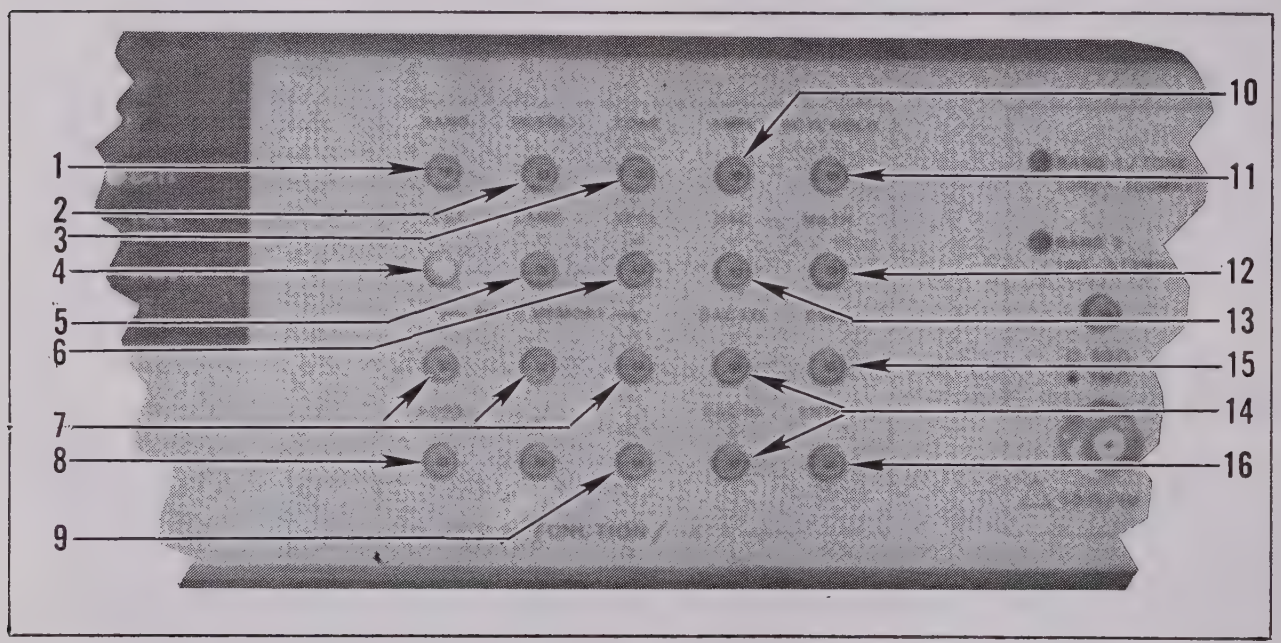


Figure 3-2. Front Panel Function/Data Controls

Table 3-1. Function/Data Controls

Index	Name	Function
1	BAND (PBI switch)	Selects input band. LED flashes until a numeric (1 thru 5) is pressed, selecting the band. The green band LED of the band selected illuminates.
2	RESOL (PBI switch)	Selects measurement resolution. LED flashes until a numeric (0 thru 6) or the minus sign and a numeric (1 thru 3) is pressed. For 1 Hz resolution press 0, for 10 Hz resolution press 1, press 2 for 100 Hz etc. For 0.1 Hz resolution press -1, press -2 for 0.01 Hz and -3 for 0.001 Hz. Resolution for Band 4 is -3 thru 6, -3 thru 2 is phased locked L.O. and 3 thru 6 is frequency locked L.O.

Table 3-1. Function/Data Controls (Cont'd)

Index	Name	Function
	RESOL (Cont'd)	Resolution for Tone: 0 is 1 second gate, 1 is 0.1 second gate, etc. Actual gate time is never less than one period of the input signal. The displayed resolution is eight digits for 1 second of gate time, seven digits for 0.1 second etc. For resolution 0 thru 6, the displayed resolution is rounded off to 0.001 Hz. For resolution -1 thru -3, the display is allowd to shift left and display better than 0.001 Hz resolution.
3	TONE (PBI switch)	Selects tone (expanded frequency) frequency mode of operation, activates Band 1 and lower Annunciator LED's illuminate.
4	TEST (PBI switch)	Selects instrument self test measurement, TEST LED and upper annunciator row illuminate. Instrument measures internal 100 MHz time base and display indicates 100 000 000.
5	LAMP (PBI switch)	Initiates lamp test. Turns off all illuminated display (except LAMP and OVERLOAD if in OVERLOAD) and then cycles through. Cycles all display indicators; digital segments 0 thru 9, decimal points Gate, Talk and Remote LED's, annunciators upper row then lower row, all PBI LED's and then all Band LED's. At the end of the lamp test cycle or when RESET is pushed, the last used measurement or special function is initialized.
6	SPCL (PBI switch)	Selects special function, LED flashes. Enter a number from special function diagnostics list and press ENTER. Special function is active until a measurement function or another special function is selected. SPCL LED is steadily on.
7	MATH MEMORY	Three math memory keys (PBI switches) 1, 2 and 3. When pressed with the memory empty or the DSPL LED flashing, the math memory LED flashes. The display indicates the memory contents. When pressed and the math memory register is loaded LED is steady on. When LED is off, the math operation is disabled.
8	ADRS (PBI switch)	Displays instrument address. Press and the instrument address switches are displayed. Display indicates both the binary number and its decimal equivalent until reset or another function is selected.
9	CLR	When pressed in the register display state, the contents of the register are cleared, the register's LED turns off, the keyboard goes to a function select state and a measurement is initialized. Pressing any other data pushbutton puts the keyboard in the data entry state.

Table 3-1. Function/Data Controls (Cont'd)

Index	Name	Function
9	CLR (Cont'd)	When pressed in a data entry state, the contents of the selected register are not affected, the display goes to zero, and the selected register continues to flash.
10	AMPL (PBI switch)	Selects amplitude measurement mode. Press and the AMPL LED turns on and a measurement is initialized. When a signal is acquired, the LOCK LED and the Band 3 or 4 (automatically selected) LED will turn on. The display reads out the input signal frequency in MHz and amplitude in xx.x dBm.
11	RCYL HOLD (PBI switch)	Inhibits automatic reset and retains the last measurement for display indefinitely. LED is illuminated in the HOLD mode, LED off and the display is recycled as controlled by the gate time and recycle rate setting.
12	MATH (PBI switch)	Selects the math program mode. When LED is on any stored math operations are applied to the measurement before the measurement is sent to the display.
13	DAC (PBI switch)	Provides DAC memory/enable. When pressed with the DSPL LED flashing, the DAC LED will flash and the display will indicate the memory contents. Data may be entered or changed as follows: 1. When in the 3-digit mode, a digit or a minus sign and a digit (-3 to 9) are entered. 10 raised to the power of the entered value is the place value of the least significant digit of the 3 on display. 2. When in the frequency lock mode, the data equals the desired lock frequency. Pressing when the LED is on, Pressing when the LED is on, inhibits the DAC mode, turning off the LED and setting the DAC output to zero.
14	DAC LO (PBI switch) and DAC HI (PBI switch)	DAC Low and high register memory/enable keys. When pressed with the memory empty or the DSPL LED flashing, the DAC LO/DAC HI LED flashes, and the display indicates the memory contents of the selected register, and data (frequency or amplitude) may be entered or changed. When the DAC LO/DAC HI LED is steady on the interpolate mode is enabled. When the DAC LO/DAC HI LED is off, the interpolate mode is disabled. When in the frequency lock mode (SPCL 63) the LED is normally off.

Table 3-1. Function/Data Controls (Cont'd)

Index	Name	Function
15	DSPL (PBI switch)	Selects register display. When pressed in any keyboard state, LED flashes, then follow by pressing a MATH MEMORY, DAC, DAC LO or DAC HI, the LED of the pushed button flashes and the contents of the selected register is displayed. The keyboard is in a Register Display state.
16	ENTER (PBI switch)	When pressed in any data entry state, the entered data is stored and the keyboard goes to the function select state; and if entered into a register, the register LED is steadily on.

3-11. Math Key Pad Operation

3-12. Up to three levels of Math operation are used to modify the measurement displayed to allow for offset (+ or -), scaling (X) and normalization ( ) of the measurement. Each math operation consists of a signed (up to 12 digits) number and an operator (+, -, X or $\div$). Each function has a separate math memory. Therefore, math operations must be entered for each function.

3-13. The MATH PBI switch will enable or disable the math function. When math LED is illuminated, the displayed measurement is modified to the numerical value(s) and operator(s) stored in the selected memory. When the LED is extinguished, the math functions are retained in memory but the measurement will be unmodified.

3-14. Display Section

3-15. The display section of the front panel is shown in figure 3-3, and table 3-2 describes it.

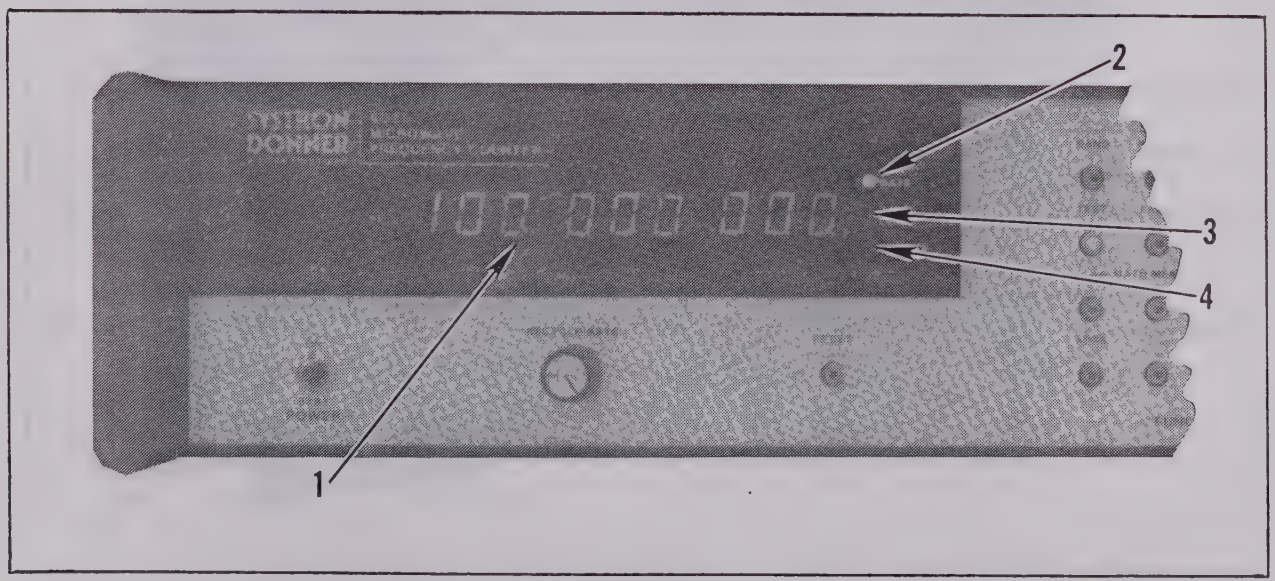


Figure 3-3. Front Panel Display Section

Table 3-2. Display Section

Index	Name	Function
1	Digital Display	Twelve-digit 0.4" high numerical in-line readout, leading zero suppression and illuminated measurement annunciator. Two rows of annunciators. The top row GHz, MHz, kHz and Hz annunciators are directly below the appropriate 3 digit display and denote the measured frequency. The bottom row is activated when in Tone or Amplitude and display MHz, kHz, Hz and dBm. (dBm is illuminated only in Amplitude.)
2	GATE	LED annunciator. Illuminates during the gate on period.
3	TALK ONLY	LED annunciator. Illuminates to indicate the GPIB function is placed into the Talk only mode by the rear panel PROG/TALK ONLY switch.
.4	REMOTE	LED annunciator. Illuminates to indicate when the instrument is being remotely controlled via GPIB.

3-16. Input Section

3-17. The input section for the 6030 is depicted in figure 3-4 and table 3-3 describes the respective inputs. The 6020 input section is identical to the 6030 except for the Band 3 and 4 Input connector (J3).

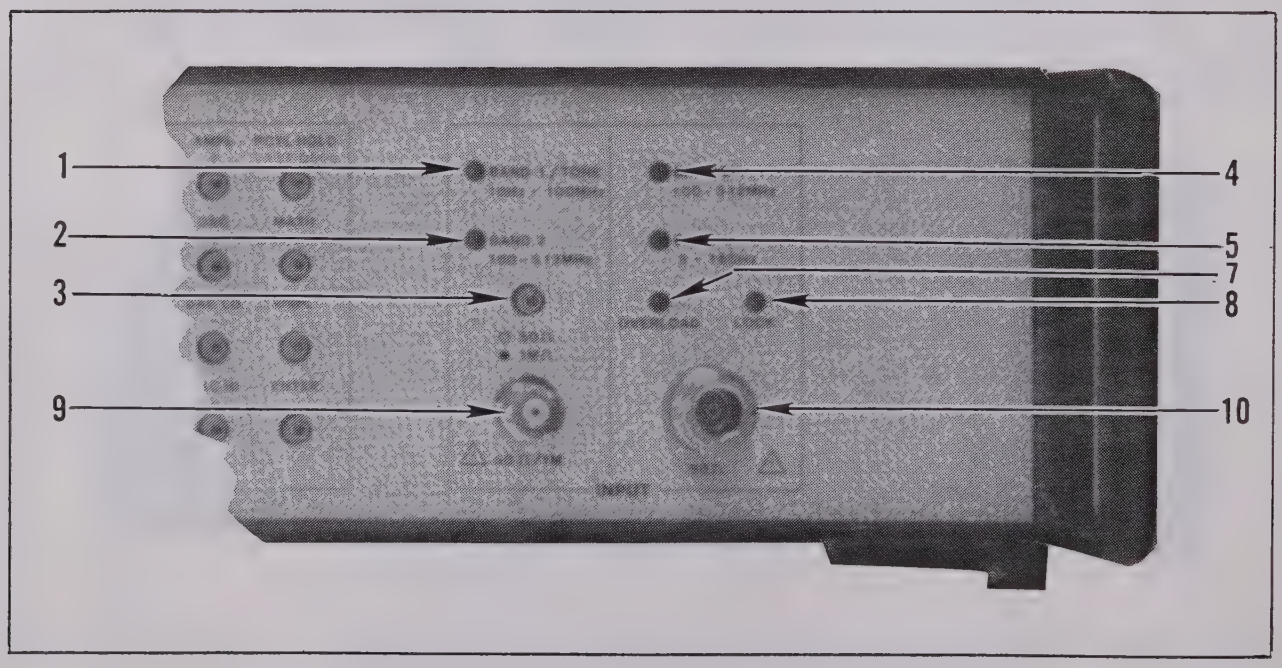


Figure 3-4. Model 6030 Front Panel Input Section

Table 3-3. Input Section

Index	Name	Function
1	BAND 1/TONE 10 Hz to 100 MHz	LED (Green) illuminated to indicate instrument programmed for Band 1 or Tone.
2	BAND 2 100-512 MHz	LED (Green) illuminates to indicate the instrument is programmed for Band 2.
3	50 Ω/1 MΩ (PBI switch)	Selects either 50 Ω or 1 Megohm input impedance, LED illuminates when 50 Ω impedance is selected. Applicable to Band 1 and Band 2 inputs only.
4	BAND 3 100-512 MHz	LED (Green) illuminates to indicate the instrument is programmed for Band 3.
5	BAND 4 .5-18 GHz/ .5-26.5 GHz	LED (Green) illuminates to indicate the instrument is programmed for Band 4.
6		Not used on current instrument, Band 5 Frequency Extender Option.
7	OVERLOAD	LED, flashes whenever the Band 3 and 4 leveler detects an overload condition.
8	LOCK	LED, illuminates whenever Band 3, 4 or 5 is the frequency range and acquisition of the input signal has been obtained.
9	BAND 1/2 INPUT 50 Ω/1 M 	BNC connector, Band 1/Tone, 10 Hz to 100 MHz, and Band 2 100 to 512 MHz, input. CAUTION damage may be sustained by the counter if >5 V p-p is applied when 50 Ω input is selected. Maximum input without damage when 1 MΩ selected is 125 V rms to 500 kHz; 50 V rms 500 kHz to 5 MHz and 10 V rms 5 to 100 MHz.
10	BAND 3/4 INPUT 50 Ω 	Model 6020: N connector, Band 3, 100 to 512 MHz, and Band 4, .5 to 18 GHz, input. Model 6030: SMA connector Band 3, 100 to 512 MHz, and Band 4, .5 to 26.5 GHz, input. CAUTION damage may be sustained if a signal having a level >25 dBm is applied.
11		Not used on current instrument, Band 5 Frequency Extender Option.

3-18. Rear Panel Features

3-19. Figure 3-5 depicts the rear panel of the 6020/6030 Frequency Counters. Table 3-4 describes the function of the connectors, switches and fuses located on the rear panel.

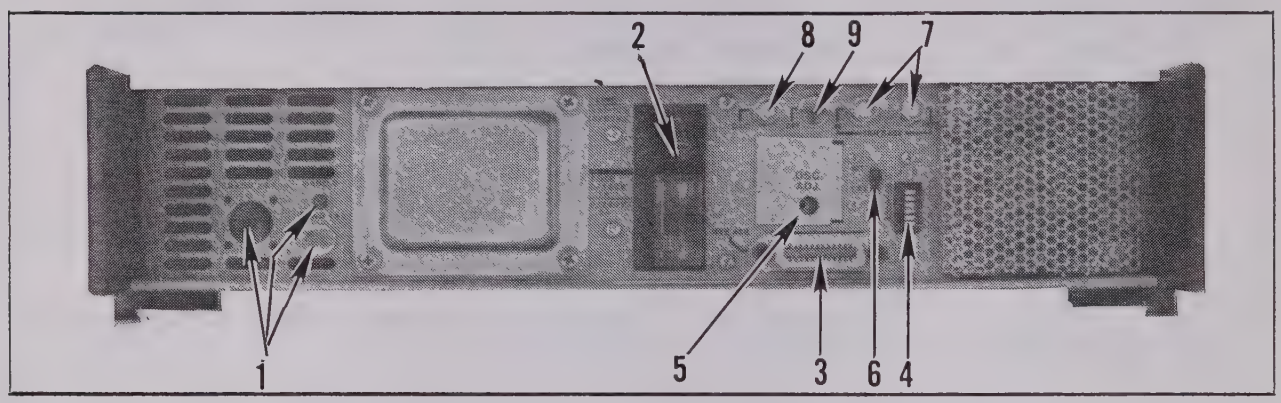


Figure 3-5. 6020/6030 Rear Panel

Table 3-4. Rear Panel Operational Features

Index	Name	Function
1	Band 1 and 2 Band 3 and 4	Optional rear panel input connectors, button plugs if not installed.
2	Power Receptacle	J1 main power receptacle houses line fuse, power selection board, line filter and 3 prong NEMA jack.
3	IEEE-488	IEEE Std 488 connector provides for interfacing of the counter with the GPIB.
4	ADDRESS PROG/TALK ONLY	Six digit switch assembly. Selects instrument address, and PROG (program) or TALK ONLY Mode. Full GPIB handshake functions are enabled when PROG is selected. When TALK ONLY is selected, the acceptor handshake (AH1) is inhibited allowing the counter to become a GPIB source (talker) only device. The five 0/1 switches provide for the assignment of a specific 5-bit GPIB address for the counter.
5	OSC ADJ	Time base oscillator adjust access cover.
6	INT/EXT	Slide switch, selects internal 10 MHz oscillator (INT position) or 1 MHz/10 MHz external frequency standard input to drive the time base circuitry.

Table 3-4. Rear Panel Operational Features (Cont'd)

Index	Name	Function
7	TIMEBASE IN OUT	BNC connectors. IN connector provides for input of the external time base oscillator signal. (1 MHz or 10 MHz 500 mV sinewave or squarewave.) OUT connector provides an output of 10 MHz or 1 MHz 2 V p-p internal time base oscillator signal into 50 Ω.
8	DAC	BNC connector. DAC output connector provides analog output voltage for the Digital-To-Analog Converter.
9	DFI	2 pin Amphenol connector. Provides DFI (discrete fault indicator) flag output.

3-20. MEASUREMENT CONSIDERATIONS

3-21. When the Counter is used to make critical measurements, several factors which can cause errors in measurement must be considered. The following paragraphs describe the significant error producing factors, and explain in detail the Counters specifications and characteristics and their affect on the accuracy of measurement.

3-22. When discussing accuracy of measurement, the term accuracy must first be defined. Accuracy may be defined as the quality of exactness or as the closeness of a measurement to a true value as fixed by an accepted standard. The basic unit for frequency and time measurements is the second and is defined as the duration of 9,191,631,770 periods of the transistion within the cesium atom. The two most accepted national standards are the National Bureau of Standards (NBS), Colorado and the U.S. Navel Observatory (USNO), Washington, D.C. which use cesium beam atomic clocks as primary standards.

3-23. MEASUREMENT ERRORS

3-24. The sources of measurement error can be categorized into four types:

1. Gating ambiguity errors
2. Time base errors
3. Trigger errors
4. Systematic errors

3-25. Trigger errors and systematic errors are not typical to frequency counters and the detrimental effect is insignificant.

3-26. Gating Ambiguity Errors

3-27. The Counter is subject to an irreducible plus or minus one count error in the LSD of the display, when operating in the normal gate mode. This error is present because of the noncoherance between the signal being measured and the time base oscillator, which controls opening and closing of the main count gate. The first or last pulse of the signal being counted may or may not be gated into the count register during the the selected count gate on interval. As the frequency measured is increased, the percentage of error is reduced because it becomes less significant as compared to the total count. Thus, the percentage of error is a function of the frequency (rate) being measured, and the number of pulses counted, i.e., the gate count time selected. While normally insignificant at higher frequencies, this error becomes more important at lower frequencies. For this reason the reciprocal mode is selected to obtain greater accuracy when measuring low frequencies.

3-28. Reciprocal counting provides two major advantages: (1) the ±1 count quantization error is independent of the input signal frequency being counted

(hence, for noiseless inputs and assuming negligible trigger and time base error, the resolution of reciprocal counting is also independent of the input signal frequency); (2) the reciprocal technique provides control of the count gate in real time.

3-29. For a given gate time, the ±1 count quantization error for frequency counting is inversely proportional to the input frequency. In reciprocal counting, for the same gate time, the quantization error is constant and is determined by the period of the counted clock. Thus, the quantization error is less when the reciprocal technique is used for all input frequencies that are less than the clock frequency. The difference in the ±1 count quantization error between frequency counting and reciprocal counting is shown in figure 3-6.

3-30. Time Base Error

3-31. The gating precision, and therefore the accuracy of the measurement, is dependent upon the stability of the time base oscillator frequency.

3-32. The stability of the time base oscillator may be stated as the maximum fractional frequency change due to all error sources (e.g., aging, temperature, and line voltage). The actual error in any particular measurement can be found by multiplying the total $\Delta f/f$ of the time base oscillator (or $\Delta t/t$ which equals $\Delta f/f$) by the measured quantity. For example, if the standard time base oscillator is specified as:

Frequency:	±1 part in 10^8/day.
Aging Rate:	±3 parts in 10^7/month. ±1 part in 10^6/year.
Temperature:	±5 parts in 10^7 over 0 to +50°C.
Line Voltage:	±5 parts in 10^8 for 10% change from nominal.

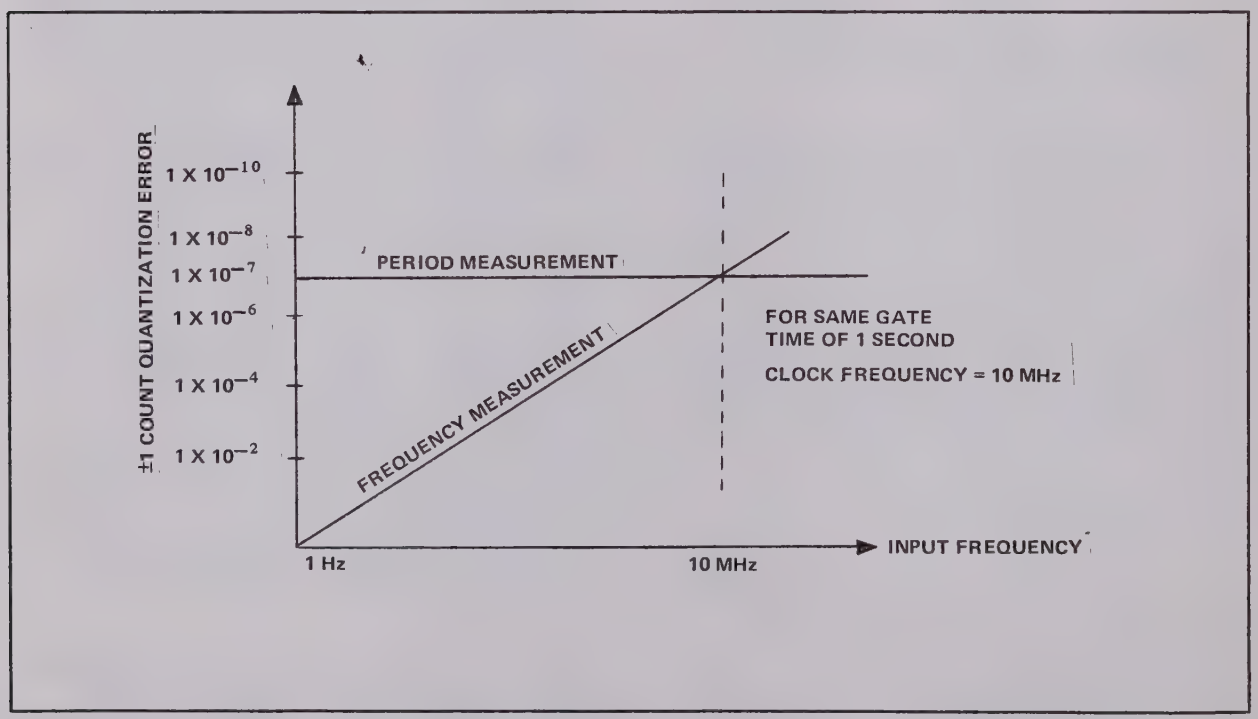


Figure 3-6. Gating Ambiguity Error, Reciprocal Counting vs. Frequency Counting

3-33. What is the time base error in the measurement of 5 MHz input signal if the counter has not been calibrated for one month and the temperature change from when it was calibrated to time of measurement is 7°C at the most.

$$\frac{\Delta f}{f}_{\text{Aging}} = \pm 3 \times 10^{-7}$$

$$\frac{\Delta f}{f}_{\text{Temperature}} = \pm 5 \times 10^{-7} \times \frac{7^\circ C}{50^\circ C} = \pm 7 \times 10^{-8}$$

$$\frac{\Delta f}{f}_{\text{Line Voltage}} = \pm 5 \times 10^{-8}$$

$$\frac{\Delta f}{f}_{\text{Total}} = \pm 3 \times 10^{-7}\ \pm 7 \times 10^{-8}\ \pm 5 \times 10^{-8} = \pm 4.2 \times 10^{-7}$$

$$\Delta f \text{ Error} = f \times \frac{\Delta f}{f} = 5 \times 10^{-6} \times \pm 4.2 \times 10^{-7} = \pm 2.1 \text{ Hz}$$

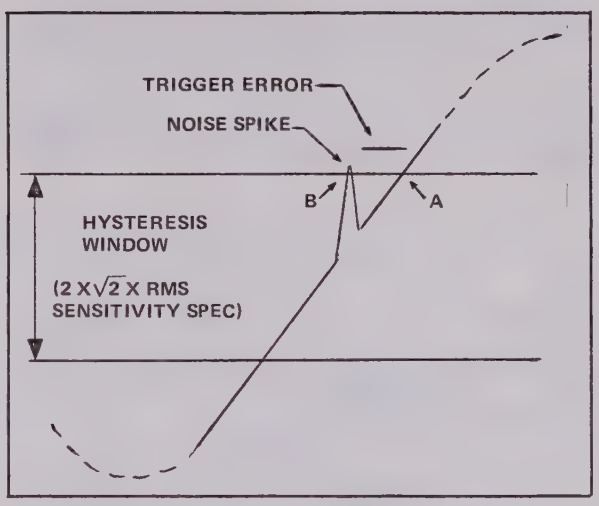


Figure 3-7. Trigger Error

3-34. Trigger Error

3-35. When reciprocal measurements are made, the input signal controls the opening and closing of the count gate. Small noise spikes on the input signal can cause the count gate to open and close either too early or too late, allowing the accumulation of too few to too many counts. Referring to figure 3-7, an input signal is shown passing through the hysteresis window of the input amplifier trigger circuit. In the absence of noise, the count gate would open at point A. The noise spike shown has sufficient amplitude to cross the upper hysteresis limit, thus causing the count gate to open early at point B and induce a trigger error.

3-36. The hysteresis band is determined by the sensitivity specification, while the triggering responds to a peak-to-peak signal.

3-37. OPERATING CHARACTERISTICS

3-38. The following paragraphs describe the operating range, resolution, FM tolerance, dynamic range and overload characteristics of the 6020/6030 Frequency Counter.

3-39. Operating Ranges. There are five operating ranges available (four for the 6020); 10 Hz to 100 MHz, 100 to 512 MHz, 0.5 to 18/26.5 GHz and above 26.5 GHz. Frequencies in the BAND 1/TONE range 10 Hz to 100 MHz are input to the 50 Ω/1 M INPUT bnc connector and measured directly. The input impedance 50 Ω or 1 MΩ is selectable. Frequencies in the BAND 2 range 100 to 512 MHz are input to the 50 Ω/1 M INPUT bnc and are prescaled (4) then measured directly. The input impedance for Band 2 is 50 Ω or 1 MΩ selectable. Frequencies in the BAND 3 range. also 100 to 512, MHz are input to the 50 Ω N/SMA INPUT connector prescaled (4) then measured directly. Frequencies in the BAND 4 range 0.5 to 18/26.5 GHz are made using the FLACTO (Frequency Locked Automatic Computing Transfer Oscillator) technique. Frequencies above 26.5 GHz (BAND 5 6030 only) are applied via the Remote Sensor then measured using the FLACTO technique.

3-40. Resolution and blanking. Resolution is defined as the value represented by the LSD (least significant digit) displayed. Resolution from 0.001 to 1 MHz in decade steps is available. Those digits below the resolution setting are blanked. Resolution once selected is stored in memory until changed or power down.

3-41. FM Characteristics. The FLACTO technique provides measurement of micro-

wave carrier frequencies in the presence of high levels of frequency modulation, phase modulation and residual noise. The fm characteristics are a function of the modulation rate and the carrier frequency as shown in figure 3-8.

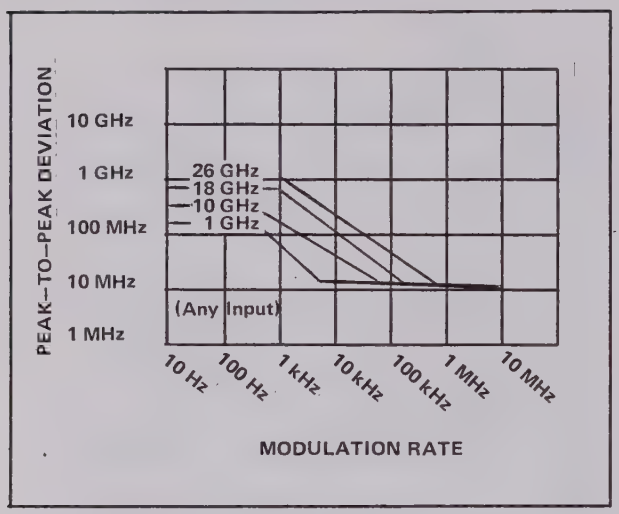


Figure 3-8. FM Characteristics

3-42. Dynamic Range and Overload Protection. The FLACTO technique provides excellent sensitivity for low level signals along with high power protection. Operative dynamic range is the term used to define the parameters that determine the range of input power levels, maximum power without damage and pending overload indication. Figure 3-9 depicts the wide dynamic operating range from -30 to +30 dBm over the instruments entire frequency band.

3-43. Two front panel LED Indicators and the digital display itself provide a constant display of signal strength. When the input signal level is equal to or above the counter sensitivity a green LOCK LED indicator illuminates and the digital display reads the frequency. When the input signal level is below the lock level the readout displays all zero's. At approximately +20 dBm (100 mW) the red OVERLOAD LED will flash to provide a warning of potential signal overload, and the display will indicate OVERLOAD until the RESET pushbutton switch is pressed.

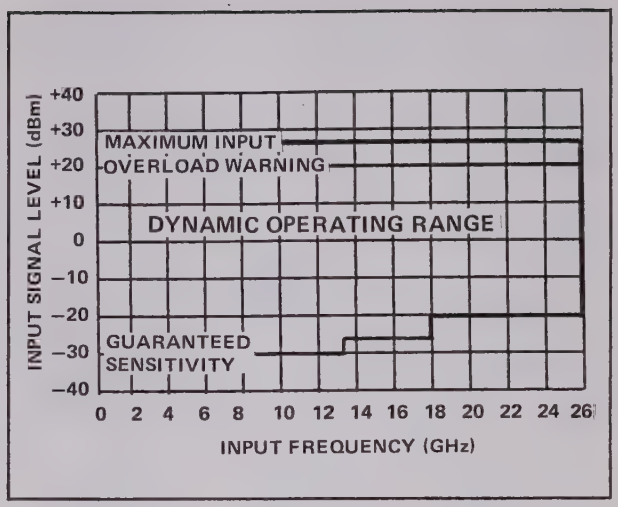


Figure 3-9. Dynamic Operating Range

3-44. OPERATING PROCEDURES

3-45. Prior to operation, ensure the line switch is set to the available line voltage. If a high stability oscillator is installed, so allow at least one hour warm-up and check the time base oscillator output on the rear panel to ensure oscillator is properly calibrated. If an external time base is employed set rear panel TIMEBASE switch to EXT and apply external oscillator signal to timebase IN.

3-46. RECEIVING INSPECTION TEST

3-47. The following procedure performs an operational check on the instrument and may be used as a confidence check for maintenance purposes, incoming inspection, troubleshooting etc. No special tools or equipment is required.

1. Turn front panel POWER switch off (STBY). Check fuse rating and line voltage selector. If line voltage is correct connect power cord to instrument and appropriate power source. Time Base Oscillator switch should be set to INT.

2. Turn POWER switch ON. Instrument wakes up in the TEST Mode, 1 Hz resolution and 1 megohm input. Initial power on initiates a self check of the instru-

ment. If a fault is detected, the display indicates FAULT and a code number and waits for any key to be pressed before continuing test. If an out of tolerance calibration level is detected, the display indicates the affected circuit (e.g. TB UNLOCKED) and waits for any function key to be pressed.

3. Press TEST: GATE LED blinks, TEST LED steady on, upper annunciator row illuminates, display reads 100 000 000.

4. Press LAMP: Lamp LED lights, the display digits are cycled 0 through 9 and decimal points, the upper and lower annunciator rows are illuminated then each LED is illuminated in sequence starting at GATE and ending with BAND 5. When lamp test is completed the instrument returns to the operating function in use prior to lamp test, in this instance TEST.

5. Press RESOL: Resolution LED flashes until a numeric digit 0 through 6 or a minus sign and a numeric digit 1 through 3 is pressed.

press RESOL then 0 for 1 Hz resolution, display reads 100 000 000 with upper annunciator row lit.

press RESOL then 1 for 10 Hz resolution, display reads 100 000 00b with upper annunciator row lit. (b denotes a blank digit).

press RESOL then 2 for 100 Hz resolution, display reads 100 000 0bb with upper annunciator row lit.

press RESOL then 3 for 1 kHz resolution, display reads 100 000 bbb with upper annunciator row lit.

press RESOL then 4 for 10 kHz resolution, display reads 100 00b bbb with upper annunciator row lit.

press RESOL then 5 for 100 kHz resolution, display reads 100 0bb bbb with upper annunciator row lit.

press RESOL then 6 for 1 MHz resolution, display reads 100 bbb bbb with upper annunciator row lit.

press RESOL then 0 to return instrument to 1 Hz resolution.

6. Press MATH MEMORY 1: MATH MEMORY 1 LED flashes and display reads 0.

press +: MATH MEMORY 1 LED flashes, + LED steady on, display reads 0 MHz with upper annunciator row lit.

press 555: MATH MEMORY 1 LED flashes, + LED steady on, display reads 555 MHz with upper annunciator row lit.

press ENTER: MATH MEMORY LED steady on, display reads 655 000 000 with upper annunciator row lit.

press MATH MEMORY 1 and MATH: Both LED's off, display reads 100 000 000 with upper annunciator row lit.

7. Press MATH MEMORY 2: MATH MEMORY 2 LED flashes and display reads 0.

press X: MATH MEMORY 2 LED flashes, X LED steady on, display reads 0.

press 2: MATH MEMORY 2 LED flashes, X LED steady on, display reads 2 with upper annunciator row lit.

press ENTER: MATH MEMORY 2 steady on, MATH LED on, and display reads 200 000 006 with upper annunciator row lit.

press MATH MEMORY 2 and MATH: Both LED's go off and display reads 100 000 000 with upper annunciator row lit.

8. Press MATH MEMORY 3: MATH MEMORY 3 flashes and display reads 0.

press : MATH MEMORY 3 LED flashes, LED steady on, display reads 0.

press 4: MATH MEMORY 3 LED flashes, LED steady on, display reads 4.

press ENTER: MATH MEMORY 3 LED steady on, MATH LED steady on and display reads 25 000 000 with upper annunciator row lit.

press MATH MEMORY 3 and MATH: Both LED's go off and display reads 100 000 000 with upper annunciator row lit.

9. Press MATH: MATH LED comes on, display reads 100 000 000 with upper annunciator row lit.

press MATH MEMORY 1: MATH MEMORY 1 LED comes on and display reads 655 000 000 with upper annunciator row lit. (100 MHz +555 MHz.)

press MATH MEMORY 2: MATH MEMORY 2 LED comes on, MATH MEMORY and MATH steady on and display reads 1310 000 006 with upper annunciator row lit. (100 MHz +555 MHz x 2.)

press MATH MEMORY 3: MATH MEMORY 3 LED comes on, MATH MEMORY 1, MATH MEMORY 2 and MATH steady on and display reads 327 500 000 with upper annunciator row lit. (100 +555 x 2 ÷4.)

10. Press MATH, MATH MEMORY 1, MATH MEMORY 2 and MATH MEMORY 3: All math LED's go off and display reads 100 000 000 with upper annunciator row lit.

11. Press DSPL: DSPL LED flashes and the display goes blank.

press MATH MEMORY 1: MATH MEMORY 1 and + LED's come on, DSPL LED goes off and display reads 555 MHz.

press CLR: MATH MEMORY 1 and + LED's go off, display reads 100 000 000 with upper annunciator now lit. This clears MATH MEMORY 1 register.

12. Press DSPL: DSPL LED flashes and display is blank.

press MATH MEMORY 2: MATH MEMORY 2 and X LED's steady on, DSPL LED off and display reads 2.

press CLR: MATH MEMORY 2 and X LED's go off and display reads 100 000 000 with upper annunciator row lit. This clears MATH MEMORY 2 register. To clear MATH MEMORY 3 repeat the the procedure - DSPL, MATH MEMORY, CLR.

13. Press ADRS: The display reads out the word Adr and both the binary number and its decimal equivalent. e.g. Adr 9 01001 or Adr 15 01111.

14. This completes the performance confidence check.

3-48. BAND 1 10 Hz to 100 MHz OPERATION

1. Turn power on, set RECYCLE RATE fully clockwise or as appropriate.

2. Select BAND 1; press BAND and 1. Band 1/Tone LED illuminates, upper annunciator row illuminates.

3. Connect a suitable signal source, 10 Hz to 100 MHz, to the 50 Ω/1 M INPUT. Maximum signal 5 V p-p for 50 Ω; for 1 megohm, 125 V rms to 500 kHz, 50 V rms 500 kHz to 5 MHz, and 10 V rms 5 to 100 MHz. Minimum signal 25 mV rms 50 Ω, 50 mV rms for 1 megohm.

4. Select desired resolution; press RESOL and a number corresponding to desired resolution. 0 for 1 Hz, 3 for 1 kHz resolution etc. Display digits below the desired resolution are blanked.

5. Select desired input impedance; press 50 Ω/1 M PBI will illuminate for 50 Ω input. For 1 megohm input indicator is off.

6. Read the input frequency on the display.

3-49. Band 2 100 to 512 MHz Operation

1. Turn power on, set RECYCLE RATE as appropriate.

2. Select BAND 2, press BAND and 2. Upper annunciator now illuminated.

3. Connect a suitable signal source, 100 to 512 MHz, to the 50 Ω/1 MΩ Input. Maximum signal 5 V rms, minimum input -25 dBm.

4. Select desired input impedance: 50 Ω/1 MΩ PBI will illuminate for 50 Ω and extinguish for 1 MΩ.

5. Select desired resolution, 1 Hz to 1 MHz. Press RESOL and number key.

6. Read the input frequency on the display.

3-50. Band 3 100 to 512 MHz Operation

1. Turn power on, set RECYCLE RATE as appropriate.

2. Select BAND 3, press BAND and 3. Upper annunciator row illuminated.

3. Connect a suitable signal source, 100 to 512 MHz, to the 50 Ω INPUT. Maximum signal 5 V rms, minimum input -25 dBm.

4. Select desired resolution. Press RESOL and number key.

5. Read the input frequency on the display.

3-51. Band 4 500 MHz to 18/26.5 GHz Operation

1. Turn power on, set RECYCLE RATE as appropriate.

2. Select BAND 4, press BAND and 4. Upper annunciator now illuminated.

3. Connect a suitable signal source, 500 MHz to 18 GHz (6020)/26.5 GHz (6030), to the 50 Ω INPUT. Maximum signal +30 dBm, minimum input -30 dBm to 12.4 GHz, -25 dBm to 18 GHz and -20 dBm to 26.5 GHz.

4. Select desired resolution. Press RESOL and number key.

5. Read the input frequency on the display.

3-52. TONE 10 Hz to 100 MHz Operation

1. Turn power on, set RECYCLE RATE as appropriate.

2. Select TONE; press TONE. Lower annunciator now illuminates.

3. Connect a suitable signal source, 20 Hz to 100 MHz, to the 50 Ω/1 M INPUT.

4. Select desired resolution. Press RESOL and number key.

5. Read the input frequency on the display.

3-53. Amplitude Measurement

1. Turn power on, set RECYCLE RATE as appropriate.

2. Connect a suitable signal source to the 50 Ω Band 3 and 4 Input.

3. Select Amplitude, press AMPL. Lower annunciator row with dBm annunciator illuminates.

4. Display indicates the input frequency in MHz and the input signal level in dbm.

3-54. Offset (+-) Scaling (X) and Normalization (÷) Operation

3-55. These operations are made in any appropriate frequency mode and incorporate the math program in the measurement function. Once programmed any one of seven operations or combination of operations can be initiated. i.e. select math memory 1 or 2 or 3; or 1 and 2 and 3; or 1 and 2; or 1 and 3; or 2 and 3.

When operating multiple math memories, the operation is always performed in the order math memory 1 then 2 then 3. Not according to mathematical functions but in sequence as assigned to the respective memory registers first 1 then 2 then 3; or 1 then 3 or 2 then 3 etc.

1. Turn power on, set RECYCLE RATE as appropriate.

2. Select appropriate BAND and RESOL.

3. Connect the input signal.

4. Program +21.4 MHz to Math Memory 1.

Press MATH MEMORY 1. PBI should start flashing. If PBI comes on but does not flash, memory is programmed and will have to be cleared.

To clear Math Memory:

Press DSPL
Press Math Memory PBI
Press CLR
Press +, then 2, 1, ., and 4.
Press ENTER.

5. The display will indicate the input frequency plus 21.4 MHz with MATH PBI and MATH MEMORY 1 PBI steady on. e.g. if input is 250 Mhz display will read 271 400 000.

6. Program X2 to Math Memory 2.

Press MATH MEMORY 2. PBI should start flashing.
Press X then 2.
Press Enter.

7. The display will indicate 542 800 00b (input frequency +21.4 x 2) with MATH PBI, MATH MEMORY 1 and MATH MEMORY 2 steady on.

8. Program Divide-by-4 to Math Memory 3.

Press MATH MEMORY 3. PBI should start flashing.
Press divide PBI then 4.
Press ENTER.

9. The display will indicate 135 700 000 (input frequency plus 21.4 times 2 divided by 4).

10. Press MATH PBI. PBI will go off. Display will indicate 250 000 000 with MATH MEMORY 1, 2 and 3 PBI's on.

11. Press MATH MEMORY PBI's 1, 2 and 3. The display will indicate 250 000 000 with MATH MEMORY 1, 2 and 3 PBI's off.

12. Press MATH MEMORY 3. Display remains at 250 000 000 with MATH MEMORY 3 PBI steady on.

13. Press MATH.

14. Display will indicate 62 500 000 (input divided by 4) with MATH and MATH MEMORY 3 steady on.

15. Press MATH MEMORY 1. Display will indicate 67 800 000 (input plus 21.4 divided by 4) with MATH, MATH MEMORY 1 and MATH MEMORY 3 steady on.

3-56. REMOTE OPERATING PROCEDURES (IEEE STD 488 GPIB)

3-57. The 6020/6030 instruments may be remotely operated using the installed GPIB. This interface permits the Counter to be integrated into a system outputting measurement data and receiving programming instructions as to function, mode, resolution and measurement features to be selected.

NOTE

The 6020/6030 remote GPIB programming extends to all functions and features, except power on.

3-58. IEEE Std 488 Implemented Interface Function Subsets

3-59. Incorporated into the 6020/6030 are the interface function subsets listed in table 3-5, for implementation of IEEE Std 488-1978 GPIB. For a more complete description of these subsets refer to IEEE Std 488-1978 Appendix C.

Table 3-5. Implemented Interface Function Subsets

SH1	Source Handshake, Full
AH1	Acceptor Handshake, Full
T5	Talk, Basic Talker, Unaddressed if MLA, Serial Poll, Talk Only Mode
TE0	Extended Talker, None
L4	Listen, Basic Listener, Unaddressed if MTA
LE0	Extended Listener, None
SR1	Service Request, Full
RL1	Remote Local, Full
PP0	Parallel Poll, None
DC1	Device Clear, Full
DT1	Device Trigger, Full
C0	Controller, None

3-60. Address Assignment Procedures

3-61. The 6020/6030 IEEE Std 488 address is selected manually using the rear panel 5-4-3-2-1 ADRS switches. The setting of the 5-digits to either 1 or 0 position determines which talk address (and corresponding listen address) is assigned to the Counter. Thirty different talk/listen addresses can be assigned. Refer to table 3-6 for the address to ASCII/decimal code format.

NOTE

A 11111 (decimal 31) address must not be assigned to any device interfacing the bus, since this listen and talk address is reserved for the UNL (unlisten) ASCII(?) and UNT (untalk) and ASCII (_) commands.

Table 3-6. Talk/Listen Address

Address Switch Settings					ASCII Character Listen	ASCII Character Talk	5-Bit Decimal Code
0	0	0	0	0	SP	@	00
0	0	0	0	1	!	A	01
0	0	0	1	0	"	B	02
0	0	0	1	1	#	C	03
0	0	1	0	0	$	D	04
0	0	1	0	1	%	E	05
0	0	1	1	0	&	F	06
0	0	1	1	1	'	G	07
0	1	0	0	0	(	H	08
0	1	0	0	0	)	I	09
0	1	0	1	0	*	J	10
0	1	0	1	1	+	K	11
0	1	1	0	0	'	L	12
0	1	1	0	1	-	M	13
0	1	1	1	0	.	N	14
0	1	1	1	1	/	O	15
1	0	0	0	0	0	O	16
1	0	0	0	1	1	Q	17
1	0	0	1	0	2	R	18
1	0	0	1	1	3	S	19
1	0	1	0	0	4	T	20
1	0	1	0	1	5	U	21
1	0	1	1	0	6	V	22
1	0	1	1	1	7	W	23
1	1	0	0	0	8	X	24
1	1	0	0	1	9	Y	25
1	1	0	1	0	:	Z	26
1	1	0	1	1	;	[	27
1	1	1	0	0	<	\	28
1	1	1	0	1	=	]	29
1	1	1	1	0	>	^	30

3-62. When the rear panel PROG TALK ONLY switch is placed in the PROG position, the Counter will have its listen and remote/local interface function enabled and will function as an addressable device. When the switch is placed in the TALK ONLY position, the Counter is configured into the talk only mode; thus, inhibiting its listen and remote/local functions. This mode of operation is used when the Counter is operating under its own control (no controller on bus) and outputs the measurement result to another device on the bus, such as, a printer.

3-63. The rear panel PROG/TALK ONLY switch settings are continuously being monitored by the internal MPU. The address assignment may be displayed on the Counters front panel by pressing the ADRS key.

3-64. Programming Procedure

3-35. The Counter is programmed via device commands. A device command is a string of two or more ASCII-coded bytes followed by an optional terminator. The terminator is an ASCII coma, space, semi colon, carriage return, line feed or EOI. If the terminator is not entered a termination will be implied with the start of the next command entry. The Counter can accept up to 80 characters via its input buffer. The device commands are interpreted by the Counter to generate a control function after receiving a line feed, EOI or whenever the Counter exits its listener active state (LACS). Any unrecognized characters or commands will cause the Counter to enter its error mode. The error mode may be cleared by a device clear (DCL) message or a device trigger (DT) message, a RE (reset) device command or by pressing the front panel RESET key. When cleared a new measurement cycle will be initiated. The Counter will convert lower case characters into upper case when in its listener state.

3-66. The device commands are classified into four groups:

1. Numeric Commands: A string consisting of two or three ASCII-coded bytes followed by a sequence of bytes representing a decimal number followed by a terminator. Numeric commands must be entered using the following format.

<N spaces> [sign] <J digits>
[<K digits>] [E[sign]<L digits>]

Where:
N = 0 to any value
J = 1 to 12
K = 0 to 11
L = 1 or 2 and J + K <12

If more than 12 digits are received, they are ignored. Some numeric commands accept the character strings of LD and LM for Last Display and Last Measurement.

2. Binary Commands: Consist of two or three ASCII-coded bytes followed by either 0 or 1. The 0 indicates that function is off or false, and 1 (or any non zero value) indicates that function is on or true.

3. Integer Commands: A string consisting of two or three ASCII-coded bytes followed by a 1, 2 or 3 byte sequence representing ASCII-code decimal number and terminator. Negative numbers are converted to their absolute value. If a number is outside the expected range, the parameter will be converted into a zero.

4. Terse Commands: Two ASCII-coded bytes not followed by numeric or binary value. Terse commands are used to request a specific function or subroutine to be executed by the Counter. For example, ASCII "IN" or ASCII "RE" will cause the Counter to reset.

3-67. 6020/6030 Device Commands

3-68. All control functions and features of the Counter can be programmed via the GPIB except power on. The Counter is programmed by being addressed as a listener with remote enable true and sending it device commands. Table 3-7 provides the device command menu which describes the commands. The commands are organized into functional groups for ease of description and use.

3-69. Polling and Status Byte Generation

3-70. The Counter may be polled by the controller on the generation of SRQ by serial poll. During serial poll, each device on GPIB sends its status byte on command, and the controller checks the

Table 3-7. 6020/6030 Device Command Menu

Command Group	Device Command	Equivalent Key(s)/Control(s)	Description
Function	BN(#)	BAND 1,2,3,4 or 5	Selects frequency band. Value is the same as what would be entered on the front panel. 1 for Band 1. 2 for Band 2 etc.
	AZ0	1 MΩ/50 Ω	Band 1/2 1 MΩ.
	AZ1	1 MΩ/50 Ω	Band 1/2 50 Ω.
	TN	TONE	Selects tone mode.
	AM	AMPL	Selects amplitude mode.
	TS	TEST	Selects test mode.
	SPC(#)	SPCL	Selects special function same as front panel.
Terse Commands	RE	RESET	Resets Counter.
	IN		Initializes Counter to BN1,RS0,CL0, DAC0,DHI0,DL00,DR0,TAU, WA0 and SR0 states. Clears function memory.
	SA		Sample command. A measurement is taken while in recycle hold.
	CAL	ENTER (amplitude calibration mode)	Calibrate a frequency point.
DAC	DAC0	DAC off	DAC off (DAC Output = 0 Volts.)
	DAC1	DAC, DAC LO and DAC HI LED's on	DAC Interpolate Mode on.
	DAC2	DAC LED on	DAC 3-digits Mode on.
	DAC3	DAC and SPCL LED's on	DAC Frequency Stabilize mode on.
	SPC63	SPCL63	Enable dac frequency stabilize mode. Clears dac memories.
	SPC64	SPCL64	Disable dac frequency stabilize mode. Clears dac memories.
	DAR(#)	DAC (#)	DAC resolution, selects the 3 displayed digits used (-3 to 9).

Table 3-7. 6020/6030 Device Command Menu (Cont'd)

Command Group	Device Command	Equivalent Key(s)/Control(s)	Description
	DFR(#)	DAC (#)	Frequency required for SPCL63 DAC 3
	DHI(#)	DAC HI (#)	Enters the DAC high value.
	DHILD	DAC HI LAST DISPLAY	DAC high value = Last display.
	DLO(#)	DAC LO (#)	Enters the DAC LO value.
	DLOLD		DAC low value = Last display.
Gate Control Commands	RS(#)	RESOL (#)	Selects resolution. Value is the same as what would be entered on the front panel (-3 to 6).
	CY1	RECYCLE RATE	Selects 0.25 second recycle time.
	CY2	RECYCLE RATE	Selects minimum recycle time.
	CY3	RCYL HOLD	Enables recycle hold function.
Math Commands	MA1	MATH ON	Enables math functions.
	MA0	MATH off	Disables math functions.
	MM0		Turns all 3 math memory LED's off. Doesn't affect the contents of the math memory.
	MM1	MATH MEMORY 1	Selects math memory operation register 1 and math memory 1 LED on.
	MM2	MATH MEMORY 2	Selects math memory operation register 2 and math memory 2 LED on.
	MM3	MATH MEMORY 3	Selects math memory operation register 3 and math memory 3 LED on.
	CL0		Clears all math registers, extinguishes MATH LED and all math memory LED's.
	CL1	DSPL MATH MEMORY 1 CLR	Clears math operation memory register 1.
	CL2	DSPL MATH MEMORY 2 CLR	Clears math operation memory register 2.

Table 3-7. 6020/6030 Device Command Menu (Cont'd)

Command Group	Device Command	Equivalent Key(s)/Control(s)	Description
	CL3	DSPL MATH MEMORY 3 CLR	Clears math operation memory register 3.
	AD(#)	MATH MEMORY Y # +	Add value, value of 0 will clear register, any non-zero value will enable MATH LED.
	ADLD	MATH MEMORY LAST DSPL + MATH	Add last display.
	ADLM		Add last measurement.
	SB(#)	MATH MEMORY # -	Subtract value, value of 0 will clear register, any non-zero value will enable MATH LED.
	SBLD		Subtract last display.
	SBLM		Subtract last measurement.
	ML(#)		Multiply by a value, value of 0 will clear register, any non-zero vlaue will enable MATH LED.
	MLLD		Multiply by last display.
	MLLM		Multiply by last measurement.
	DV(#)		Divide by a value, value of 0 will clear register, any non-zero will enable MATH LED.
	DVLD		Divide by last display.
	DVLM		Divide by last measurement.
	LD	LAST DSPL	Value is the last displayed measurement.
	LM	LAST MEAS	Value will be the previous measurement.
Miscellaneous Commands	WA0		Disables wait to address.
	WA1		Enables wait to address.
	SR0		Service request (SRQ) disabled.
	SR1		Service request (SRQ) enabled.

Table 3-7. 6020/6030 Device Command Menu (Cont'd)

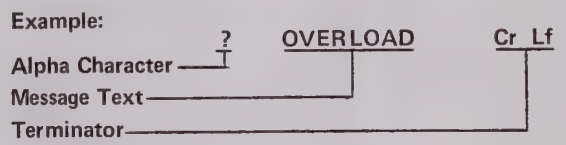
Command Group	Device Command	Equivalent Key(s)/Control(s)	Description
	TA0		Disables talk always mode.
	TA1		Enables talk always mode.
	DI(#)		Displays value on the measurement display. Number can be any value up to 11-digits (only valid in DR1 mode).
	DR0		Disables remote display mode.
	DR1		Enables remote display mode.

request bit (bit 7); thus determining which device requested service. Table 3-8 provides the status byte format for the Counter.

Table 3-8. Status Byte Format

Bit	Status
1 (LSB)	Waiting to be addressed to talk (in wait mode).
2	External time base.
3	Error, invalid device command.
4	Hardware failure.
5	(Not Used)
6	Abnormal operation, set if bit 3, 4 or 8 if set.
7	Requesting service (service request enable and bit 1, 3, 4 or 8 is set).
8 (MSB)	Microwave input overload.

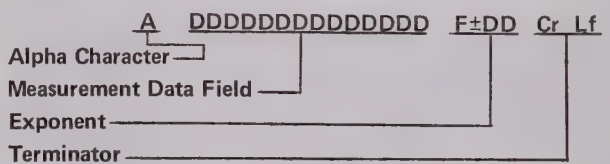
3-71. Abnormal operation messages always have a ? for the first character.



3-72. Output Data Format

3-73. After a measurement, the Counter outputs measurement data via the GPIB. The output strings contains 21 characters in the following format.

3-74. The alpha character is one-of-two single characters which precedes the measurement data to specify the type of measurement. The different alpha characters are defined as follows:



A - Amplitude measurement in dBm
F - Frequency measurement in Hz

3-75. The measurement data field consists of a 14-character string. The string consists of the sign (+ or -), followed by the digits in descending order of significance. The numerical value, however, is right-justified within the data field. Thus, to keep the number of characters constant within the total string, spaces (up to 10) are inserted preceding the sign.

3-76. The exponent is preceded by an "E" and the sign (+ or -). The output is formatted so that there is always one significant digit left of the decimal point.

3-77. A typical frequency measurement of 12.345678 MHz is illustrated below:

F(Sp)(Sp)(Sp)(Sp)+1.2345678E+07(Cr)(Lf)

3-78. Output Modes

3-79. The Counter "wakes up" or can be initialized with WA0, TA0 or SR0 output functions.

3-80. When the wait to be addressed mode is off (WA0), the Counter will output when addressed to talk and the RFD line is true and measurement data is ready. If at the end of a measurement, the Counter is not addressed to talk or the RFD is false, the measurement output string will not be sent, and a new measurement cycle will be initiated, after the recycle delay.

3-81. When the wait to be addressed mode is on (WA1) the Counter will wait to be addressed and for the RFD line to go true. In this mode, new measurements are not initiated until the data from the previous measurement is sent, or if a device command is received.

3-82. The wait to be addressed mode must be active (WA1) to generate a SRQ at the end of measurement cycle. Bit 1 (LSB) of the status byte can be used to determine the Counters end of measurement occurence. This waiting to be addressed to talk status is effective only in WA1.

3-83. When the Counter is in the talk always mode (TA1) it will output data with a value of zero, whenever it is addressed to talk and the RFD line is true and new measurement data is not ready. When the measurement is complete it will output the measurement data.

3-84. When the talk always mode is disabled (TA0) and the count gate does not open and close the Counter will not output data.

3-85. Error Messages

3-86. Initial power on initiates a self-check of the counter. If a fault is detected the display will read out an error message and the self check will go into a hold state, waiting for any key to be pressed before continuing the test sequence. Table 3-9 provides a listing of the error messages and their description.

Table 3-9. Error Messages

Error Message	Description
OVERLOAD	Band 3/4 input +20 dBm.
T.B. UNLOCK	100 MHz timebase PLL unlocked.
KEYBOARD FAIL	Closed front panel PBI switch failure in remote.
P.B. (name of PBI switch)	Closed front panel PBI switch failure in local.
SPCL(#)FAIL (Code #)	Special function diagnositc failure.
U # FAIL	RAM or ROM diagnostic failure.

Table 3-9. Error Messages (Cont'd)

Error Message	Description
1 kHz FAIL	No 1 kHz signal.
NIF FAIL	Counter C zero count of NIF.
L.O. FAIL	Counter C zero count of L.O.
PH. LOCK FAIL	ACTO phase lock error.
RAMP FAIL	Ramp Generator failure.
LOCK I.F. FAIL	No IF signal.
NUMBER ERROR	Remote numerical entry error.
SYNTAX ERROR	Remote syntax entry error.
INVALID NO.	Invalid special function entry.

3-87. DAC Operation

3-88. When the dac option 01 is enabled the dac analog output at the rear panel bnc connector is provided and up dated each count measurement cycle. Three modes of dac operation is provided: interpolate mode, 3-digit mode and frequency stabilize mode.

3-89. DAC Interpolate Mode

3-90. When the interpolate mode is selected the measured frequency (or power, if AMPL is selected) is compared to the values stored in the DAC HI and DAC LO registers and a proportional analog voltage is generated as a dac output. If the value stored in the DAC LO register is greater than the value stored in the DAC HI register, then the dac output will be inversely proportional.

3-91. To enable the dac interpolate mode, press the following pushbutton switches in sequence; DSPL, DAC LO, + or -, (#), ENTER and DSPL, DAC HI, + or -, (#) ENTER. The (#) entry is the numerical value to be entered into the registers. When DSPL, DAC LO pushbuttons are pressed, the previously entered values will be displayed. Press RESET to return.

Examples:

0 to +10 V

DAC LO = 10 GHz
Frequency measured = 12 GHz
DAC HI = 15 GHz
DAC output = +4 V

DAC LO = 15 GHz
Frequency measured = 12 GHz
DAC HI = 10 GHz
DAC output = +6 V

-10 V to +10 V

DAC LO = 10 GHz
Frequency measured = 12 GHz
DAC HI = 15 GHz
DAC output = -2 V

DAC LO = 9.999975 MHz
Frequency measured = 10.000002 MHz
DAC HI = 10.000025 MHz
DAC output = +0.8 V

3-92. DAC 3-Digit Mode

3-93. When the 3-digit mode is selected, the three adjacent digits entered will determine the dac output voltage. The place value of the least significant of the 3-digits entered, specifies the 3-digits that will be used. The least significant digit will default to "0". The 3-digit mode is not valid for the AMPL (power) function. Blank digits are treated as "0".

3-94. To enter the dac 3-digit mode press: DSPL, DAC, +/-, (digit). When DSPL, DAC, RESET is pressed the display will retain the previously entered data.

Examples:

0 to +10 V
LSD = 2
Frequency measured = 12.345678 MHz
DAC output = 4.56 V ^^^
^ ^^

LSD = 6
Frequency measured = 123.3 MHz
DAC output = +0.12 ^^^
^ ^^

-10 V to +10 V

LSD = -1
Frequency measured = 1000000.0 MHz
DAC output = -10 V ^^ ^
^^^ indicates the 3 adjacent digits entered.

3-95. Frequency Stabilize Mode

3-96. When the frequency stabilize mode is selected, the measured frequency is compared to an entered value and an analog tuning voltage is generated to tune an external frequency source to the entered (desired) frequency, thus allowing the counter to tune the frequency source.

3-97. To enable the frequency stabilize mode press: SPCL and enter digits 63. To disable the frequency stabilize mode press: SPCL and enter digits 64. When SPCL 63 or SPCL 64 is entered, the DAC registers will be cleared of all data. To enter the desired frequency value press: DSPL DAC, (#), ENTER. The (#) entry is the numerical value of the desired frequency. To enter the frequency tuned at 0 or -10 V dac output press: DSPL, DAC LO (#) ENTER. To enter the frequency tuned at +10 V dac output press: DSPL, DAC HI (#) ENTER. The (#) entry is the numerical value of the selected frequency.

Examples:

0 V to +10 V	
Source tunes	1 GHz at +1 V
	10 GHz at +10 V
Enter	DAC LO = 0 Hz
	DAC HI = 10000 MHz
Source tunes	1 GHz at +10 V
	10 GHz at +1 V
Enter	DAC LO = 11000 MHz
	DAC HI = 1000 MHz
-10 V to 0 V	
Source tunes	2 GHz at 0 V
	18 GHz at -10 V
Enter	DAC LO = 18000 MHz
	DAC HI = -16000 MHz

3-98. To enable dac operation press; DAC, operation will default to 3-digit mode if either DAC HI or DAC LO have been disabled or have not had data entered. The dac voltage range defaults (wakes-up) to 0 V to +10 V. To change voltage range enter SPCL 60 ENTER for -10 V to +10 V or SPCL 61 ENTER for 0 V to +10 V. To disable dac operation press (toggel) DAC pushbutton again, the dac output will go to 0 V. To switch from interpolate mode to 3-digit mode, toggel (disable) either DAC HI or DAC LO pushbutton. To switch from 3-digit mode to interpolate mode enter data into both DAC HI and DAC LO registers or reenable by toggeling DAC HI or DAC LO pushbuttons. The frequency lock mode can only be enabled by SPCL 63 ENTER and disabled by an SPCL 64 ENTER operation.

3-99. Special Functions

3-100. A number of special functions are provided for measurement, display and diagnostic purposes, V/F and dac range selection etc. Table 3-10 provides a listing of the special functions. To enable a special function press: SPCL, (#), ENTER. The (#) entry is the special function number.

Table 3-10.
Special Functions

	Amplitude Option
11	V/F low range (full scale voltage-to-frequency conversion for low power measurement).
12	V/F high range (divided voltage-to-frequency conversion for high power measurement).
13	Clear all calibration factors.
14	Display uncalibrated frequency points.
15	Display raw power measurements (no frequency).
16	Provides one freuqency measurement for all subsequent power measurements.
	Band 4
41	Displays N number
42	Displays 1 kHz.
43	Displays IF frequency.
44	Displays LO freuqency.
	DAC Option
60	DAC -10 V to +10 V output voltage range.
61	DAC 0 to +10 V output voltage range.
63	Enable dac frequency stabilize mode. Clears DAC memories.
64	Disable dac frequency stabilize mode. Clears DAC memories.
	Diagnostic
102	Keyboard diagnostic program.

Table 3-10.
Special Functions (Cont'd)

132	Counter A abbreviated stop on fault count chain diagnostic program.
133	Counter A abbreviated continuous count chain diagnostic program.
134	Counter B abbreviated stop on fault count chain diagnostic program.
135	Counter B abbreviated continuous count chain diagnostic program.
136	Counter C abbreviated stop on fault count chain diagnostic program.
137	Counter C abbreviated continuous count chain diagnostic program.
140	Count gate stop on fault diagnostic program.
141	Count gate continuous diagnostic program.
142	Counter A full stop on fault count chain diagnostic program.
143	Counter A full continuous count chain diagnostic program.
144	Counter B full stop on fault count chain diagnostic program.
145	Counter B full continuous count chain diagnostic program.
146	Counter C full stop on fault count chain diagnostic program.
147	Counter C full continuous count chain diagnostic program.

3-101. If a fault or failure is detected during a special function diagnostic program, an error message will be generated. The special function error message is in the following format.

SPCL(#)FAIL (Code #)

Where (#) is the special function number. The (code) is a 2-digit number which is defined as follows:

For count chain diagnostic error messages the first digit is the decade number 1 through 9 (power of 10 exponent) the 10^{th} and 11^{th} decades are not checked, the second digit is the expected count 0 through 9.

For count gate diagnostic messages (special function 140 and 141) the first digit is the gate function:

1 = ENGATE
2 = MICRO GATE
3 = DELAY STOP

The second digit is the state of the count gate:

1 = Gate reset
2 = EOC reset
3 = Gate open
4 = ECO open
5 = Gate close
6 = EOC close

www.manualsplus.com
1025017